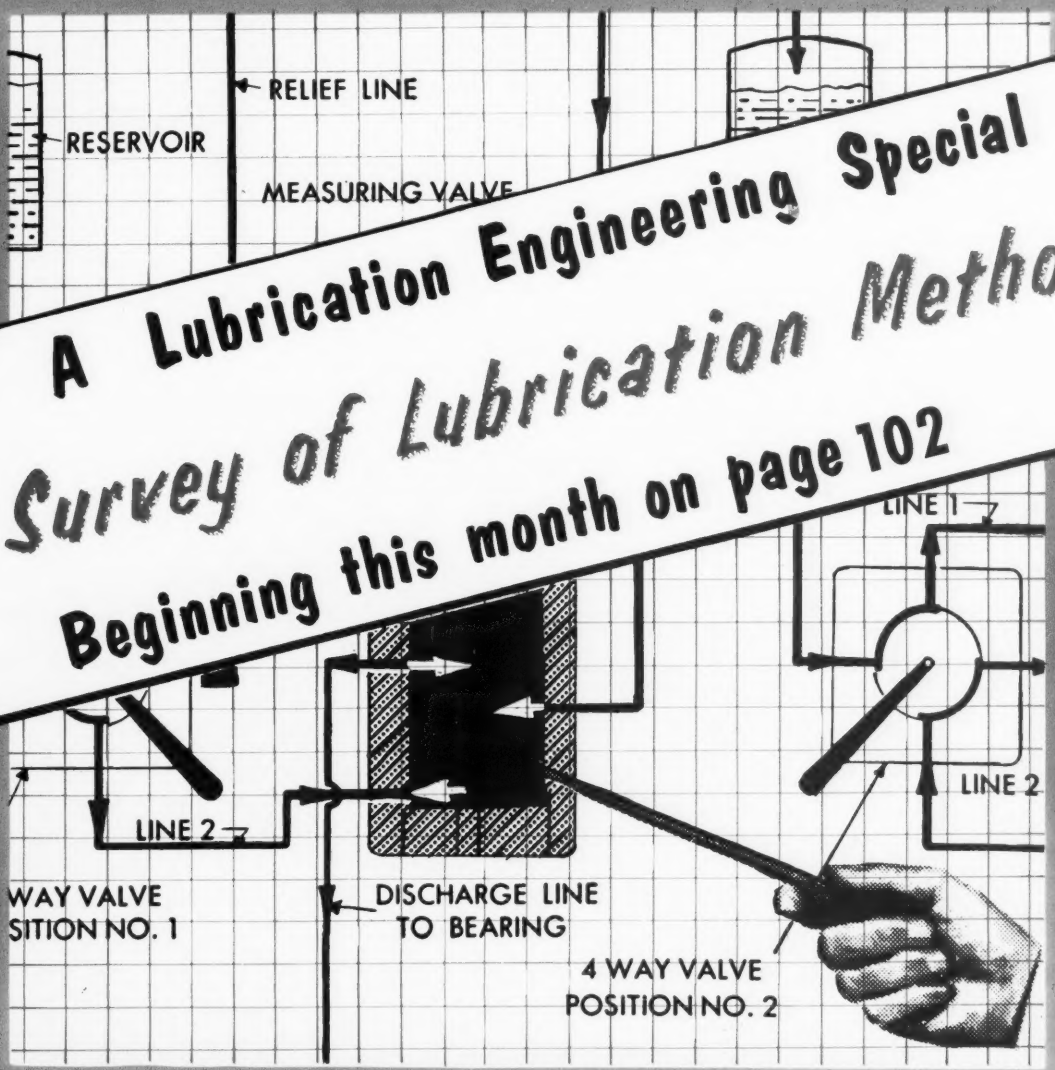
Vol. 16, No. 3 March, 1960

LUBRICATION ENGINEERING

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

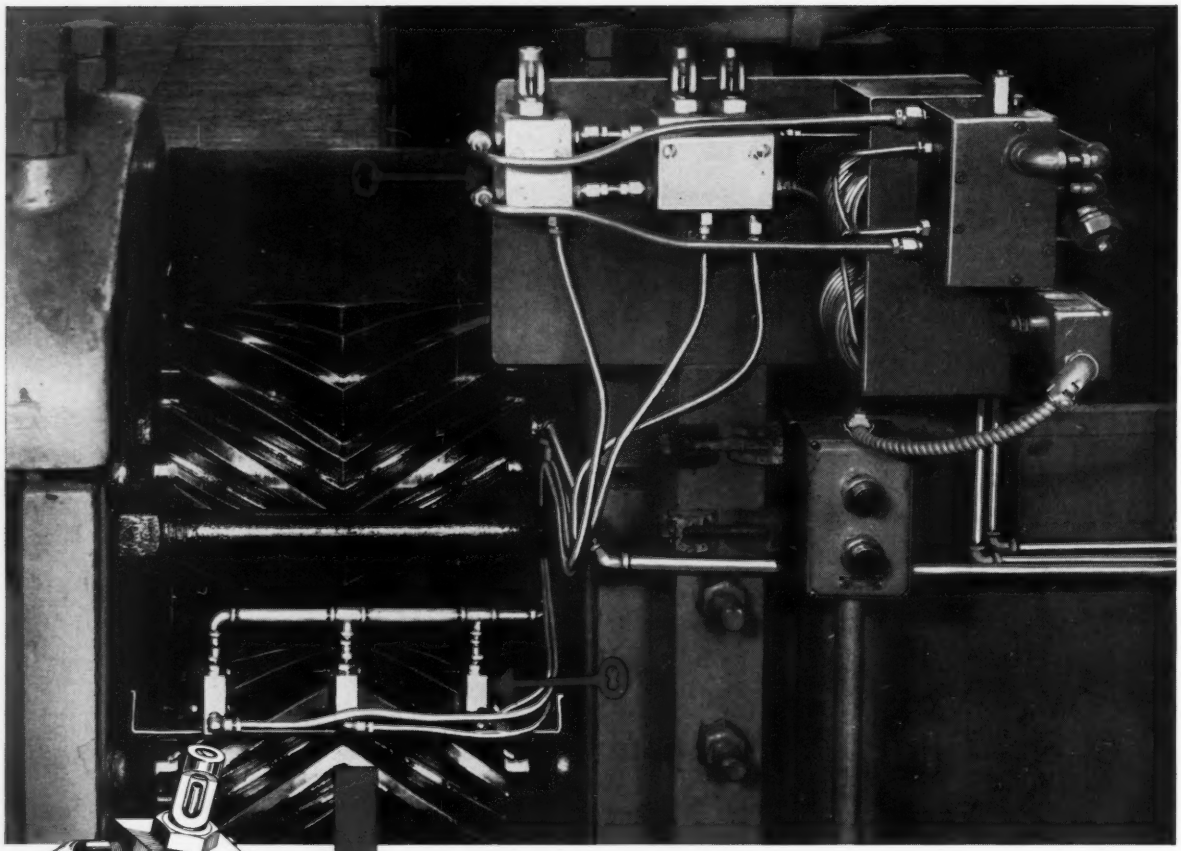


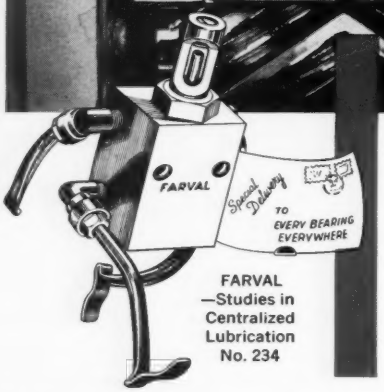
A Lubrication Engineering Special

A Survey of Lubrication Methods

Beginning this month on page 102

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS





FARVAL
—Studies in
Centralized
Lubrication
No. 234

$715.00 savings in one year paid for this automatic Farval Spray System

In this prominent brass manufacturing plant, herringbone gears for the hot commutator roll presented an acute lubrication problem. Manual lubrication procedures were inefficient, costly, and used excessive lubricant. Also, poor housekeeping – due to equipment being covered with wasted lubricant – was reflected in a high clean-up labor cost.

A modern Farval Spray Valve Lubrication System was installed and immediately solved the problems. Now the plant's operators report:

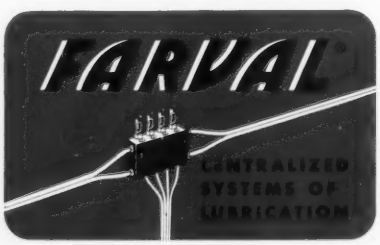
- Reduction of 84% in amount of lubricant formerly required
- Exactly measured amounts of lubricant are automatically delivered at six-minute intervals – eliminates the need for workmen to go near meshing gears
- Since installation of Farval, no maintenance has been required
- Housekeeping is no longer a problem – leakage and wasted lubricant have been entirely eliminated

Check with your Farval Representative and get the complete story on how these modern, automatic, centralized lubrication systems can improve your production operations – cut over-all costs, too. Or, write for free Bulletin 60-A.

Farval Division · Eaton Manufacturing Company
3267 East 80th Street · Cleveland 4, Ohio

KEYS TO ADEQUATE LUBRICATION

—wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.



Volume 16, No. 3
March, 1960

Lubrication Engineering

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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ANNOUNCING...

A NEW ALPHA LUBRICANT TESTING MACHINE FOR ENVIRONMENTAL RESEARCH

The new Alpha Model LFW-3 Lubricant Testing Machine has been designed to give maximum accuracy and flexibility for environmental research.

It can be adapted to the testing of either dry or liquid lubricants, at ambient to high temperatures, with oscillatory or rotational motion over a wide range of velocities and loads. A high temperature furnace is supplied as standard equipment. Sufficient space in the specimen area, however, will allow future installation of a variety of environmental chambers, including those for low temperature testing. Equipped with a 5 HP motor, the machine will operate at friction coefficients of .5 at full load.

The machine is furnished ready to operate with all electrical equipment necessary to give full protection against overload and low voltage. Instrumentation is mounted in a separate cabinet wired for easy connection to or disconnection from the testing machine.

REVIEW THESE OUTSTANDING FEATURES

- **Easily converted from solid to liquid lubricant testing.**
- **Uniform load distribution over entire test area accurately maintained.**
- **Precise testing machine accuracy throughout.**
- **Highly versatile driving mechanism giving wide range of rotating and oscillating speeds.**
- **Direct and accurate recording of friction forces.**
- **Infinitely adjustable friction limit control for automatic termination of test at preselected friction coefficient.**
- **Infinitely adjustable loading mechanism.**
- **Close control over test temperatures.**

Write today for detailed information and specifications on the Alpha Model LFW-3 as well as other lubricant testing machines in the Alpha line.

THE ALPHA-MOLYKOTE CORPORATION
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PLANTS IN
STAMFORD, CONN.
MUNICH, GERMANY
STRASBOURG, FRANCE

LUBRICATION IN THE NEWS

The Society will not be responsible for the accuracy of statements made in this column. Any reference to proprietary products does not imply an endorsement of such products by the Society.

"ORGANOMETALLICS" WONDER COMPOUNDS

Adding a metal to a solid may produce a liquid. Or adding a metal to a liquid may yield a solid. These are some of the more surprising results chemists are uncovering in developing new combinations in a class of chemicals called "organometallics."

These little-known compounds are today performing wonders in a host of everyday products. Current research indicates they will play an important role in an even wider range of products including "miracle" drugs, synthetic fibers, jet fuels and plastics. One company's laboratories have made over 3,000 of these metal-containing compounds—all different.

Organometallics are not new. Two of the best known, mercurochrome, the antiseptic, and tetraethyl lead, the antiknock compound used in gasoline, have been around for some time. Metallic atoms are part of many of the organic molecules produced in nature, such as iron in the haemoglobin of blood.

The many new possibilities opening up this field of chemistry stem from fairly recent knowledge on how to combine metallic atoms with organic molecules.

Among the innovations for the future are new drugs which show promise of combatting mental illness, and others that seem to inhibit cancer growth. Others are used as stocks for high temperature lubricants.

In lubrication applications, organometallics need not be oil-like to do the job. Some, for instance, decompose on rubbing metal surfaces, forming a friction-reducing film. Normal oils would be forced out by pressure of the moving parts, leaving them unlubricated.

The fact that these compounds can be tailor-made to meet specific needs is part of their promise.

(Source: Manufacturing Chemists Association)

CHEMISTS SALARIES

The negligible effect the recession of 1958 had on the demand for chemists is reflected in the analysis of starting salaries for graduates in the class of 1959. The survey, made by the American Chemical Society and recently published in Chemical and Engineering News, reveals that salaries for the most recent crop of chemistry graduates are up 3% from June 1958, as compared with a 0.6% rise in the cost of living during the same period.

(Source: American Chemical Society)

M. E. MERCHANT RECEIVES ASME AWARD

The ASME Memorial Award was conferred upon M. E. Merchant on December 3, 1959. Dr. Merchant is director of physical research at the Cincinnati Milling Machine Co. His work includes basic and applied research on metal cutting, grinding, forming, cutting fluids, friction and lubrication. Dr. Merchant's concept of the basic force system in metal cutting is now part of the fundamental theory of the field. He is credited with a contribution of international significance in the field of friction when he established a simple relationship governing the laws of static friction accounting for the effect of surface roughness.

M. E. MERCHANT

Dr. Merchant is an honorary member and past president of ASLE and in 1959 he was recipient of the National Award —ASLE's highest award given in recognition of an outstanding contribution in the field of lubrication.

INCREASE EXPECTED IN R&D SPENDING

The National Science Foundation reports that in January 1959, industry employed 780,000 scientists and engineers of which 35% were engaged in research and development work. Engineers totalled 630,000 (up from 605,000 in 1958) and scientists 150,000 (up from 145,000).

The Foundation estimates 1960 U. S. research and development expenditures will be over $12 billion—an increase of 140% from 1953 when national data were first collected. Industry will conduct 76% of the work, government 14%, universities 8% and other non-profit institutions 2%. However, more than half of the total tab will actually be picked up by Uncle Sam.

Details on sources and performance may be obtained from the National Science Foundation, Washington 25, D. C. Ask for Review of Data on R&D, Bulletin #16 (Dec. 1959).

(Source: National Science Foundation)

EXPANSION TO HIKE BEARING COMPANY OUTPUT

A two-million dollar expansion project starting this month at the Tyson Bearing Company, Massillon, Ohio—a division of SKF Industries, Inc.—will substantially add to the plant's tapered roller bearing capacity, according to an announcement today by E. R. Broden, SKF President.

Completion of the project in July, 1960, involving additions to both plant structure and equipment, will enable Tyson to almost triple current tapered roller bearing production in sizes ranging from four and one-half to six inches outside diameter. This size range is used in heavy farm equipment, large earthmoving vehicles, buses, tractor-trailor trucks, and medium industrial machinery.

The start of this project immediately follows completion of two earlier plant capacity expansions within the last 18 months.

Tyson Bearing Company became a division of SKF Industries, Inc., July 1, 1957, and manufactures tapered roller bearings exclusively.

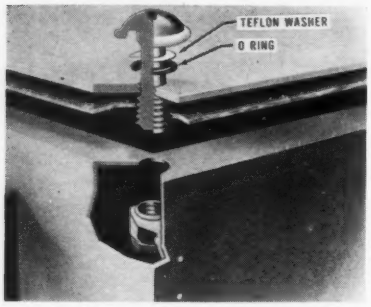
(Source: SKF Industries)

NEW PRODUCTS

The Society will not be responsible for the accuracy of statements made in this column. Any reference to proprietary products does not imply an endorsement of such products by the Society.

NEW CAPTIVE SELF-SEALING SCREWS OFFERED

A new type of pressure tight, captive self-sealing screws for use on pressurized covers, panels and cases has been developed by the Aero Bolt & Screw Co., Inc., of Inglewood, California.



Nestled in a groove in the head of the screws are any choice of the number of MIL. SPEC. O-rings, lubricated by a thin Teflon washer to prevent inadvertant galling or cutting.

Metal to metal contact is maintained at all times, assuring the user of maximum tension, as well as a leakproof seal against a wide variety of media, temperatures, and pressures.

Special metals, sealants, configurations, and drives are also available to meet the designer's special project requirements.

NYLON PRESSURE HOSE MADE AVAILABLE

Hose with a nylon inner tube reinforced with high tensile strength yarn is now available from The Polymer Corp. of Pennsylvania, Reading, Pa. Known as Nylaflow pressure hose, it is said to have one-fifth the weight and less than one-half the wall thickness of rubber hose with equivalent burst strength. Outstanding resistance to flex, pressure pulse and vibrational fatigue is claimed.

The new product reportedly is designed for improved performance in such applications as hydraulic, lubrication, fuel and oil, paint, solvent, water, freon, and high pressure pneumatic and carbon-dioxide lines. It is said to retain excellent flexibility and toughness in temperatures as low as —65 F, and can operate constantly in temperatures up to 200 F and intermittently in temperatures as high as 300 F.

Two types of Nylaflow hose are presently available with recommended maximum operating pressures of 1250 and 2000 psi (5000 and 8000 psi burst strengths respectively). Inside diameters are 1/8", 3/16", 1/4", 5/16", 3/8" and 1/2". Larger sizes available on request.

PROCESSED MINERAL CLAY SOAKS UP OILS, GREASE

Free samples of their new Oil Spunj, a specially processed sanitary mineral clay for absorbing oil and grease, have just been offered by Canfield Oil Co., Cleveland 27, Ohio.

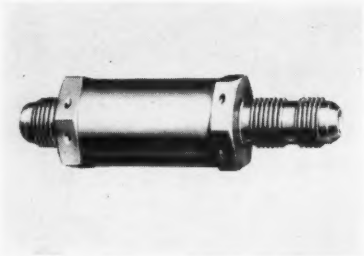
Oil Spunj is processed in granular form. Spread on wood, metal, or concrete floors, just ⅛" thick, it absorbs soluble oil, lubricating oil, grease, acids, and chemicals. Oil Spunj stays on the floor until saturated, then is easily swept off. Can be re-used with soluble oil.

According to the manufacturer, the special mineral clay used plus the unique method of processing gives Oil Spunj extreme bulk per weight, high soluble oil retention, and large floor coverage per lb. The manufacturer also states that Oil Spunj is U. L. approved and meets Government and automotive manufacturers' specifications.

HYDRAULIC CONTROL VALVE ANNOUNCED

A valve specially designed to control flow into a hydraulic motor has been announced by Fluid Regulators Corp., Painesville, Ohio.

This valve is said to stop hydraulic motor run away, preventing damage to equipment, and assuring safer working conditions for personnel.



Operating pressure for this light-weight valve (5 oz.) is 3000 psi. Normal flow is 2.2 gpm with a maximum allowable flow of 3.5 gpm and a limited flow of 0.5 gpm. Pressure drop across the valve is 20 psi (max.) for a flow of 2.2 gpm.

This speed limitor automatically limits flow when it reaches the maximum setting. After inlet pressure is reduced to 15 psi the valve automatically resets and permits normal flow.

Constructed of all stainless steel, with a bulkhead fitting on the outlet port, this speed limitor is designed to handle the usual hydraulic fluids. Specifications can be changed to meet users' requirements.

For detailed information and specifications: Write Fluid Regulators Corporation, 313 Gillette Street, Painesville, Ohio.

VISCOSITY COMPARATOR OFFERED

A pocket type viscosity comparator for on the spot checking of oil viscosity is offered by Testing Machines, Inc. It is used for locomotive, marine, stationary and aircraft engines as well as for hydraulic equipment.

Only ½ oz. of oil is needed for a test with the result being given directly in Saybolt Seconds of 100 degrees F. No other equipment is required to make the test.

The nozzle of the tester is inserted into the oil. About ½ oz. is withdrawn and the reading obtained in a few seconds. The tester can be used indoors or outdoors in any temperature.

For further information write to: Testing Machines, Inc., 72 Jericho Turnpike, Mineola, L. I., New York.

NEW ALUMINUM ROLLING OIL ANNOUNCED

Demands of the Aluminum Rolling Industry for quality maintenance while decreasing operating costs has resulted in the formulation of an improved aluminum rolling oil by the L. R. Kerns Co., Chicago.

"Kleen Strip" 485 is claimed to have a greater prime yield and to lower cost per ton while improving the mill run quality and annealing results. Especially successful on aluminum sheet and foil, this new rolling oil is said not to require any other additives or chemical compounds and therefore offers simple usage and control. Critical "new solution" or "start-up" problems are eliminated and consistent quality of runs is assured.

Mill operation checks have shown that there is no appreciable depletion of Kleen Strip 485 in plant filtration systems. This high recovery rate with less make-up additions required, results in lower overall cost and more uniform and stable rolling oil results.

For complete information on Kleen Strip 485 aluminum rolling oil, write L. R. Kerns Co., 2657 East 95th Street, Chicago, Illinois.

CLEANING COMPOUNDS STANDARDIZED

A new series of four cleaning compounds for production line cleaning of metal parts is now available.

NEW PRODUCTS
(Continued)

Duplication of cleaner characteristics often creates confusion in purchasing and using such products, believes the E. F. Houghton Company which developed the new line.

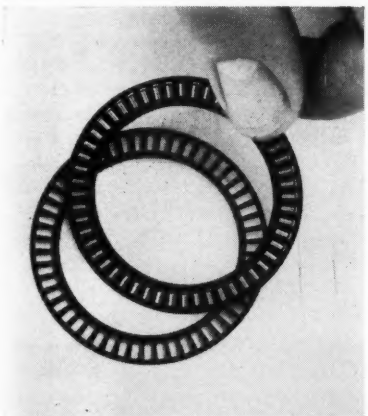
Its Cerfa-Kleen series is limited to four products which have reportedly been tailored to the exact requirements of four basic industrial metal cleaning processes and containing extra values, many of which are said to be new built-in properties.

Data sheets have been prepared for each of the new cleaners. These may be obtained by writing the E. F. Houghton Company, 303 West Lehigh Ave., Philadelphia 33, Pennsylvania.

BEARING CAGES USE GLASS-FILLED NYLON

One of the newest uses for glass-filled nylon is in the manufacture of cages for thrust bearings. A product of the Garlock Packing Company, the cages are available for either roller or ball bearings in a wide range of sizes.

Chief among the many advantages claimed is that tramp metal invading the bearing area imbeds itself into the plastic. This embedment reportedly removes ordinarily loose metal particles from circulation, reducing bearing abrasion and consequent wear of adjoining metal surfaces.



Other gains are said to be a significant reduction of assembly time and initial material cost savings. Molded-in retention cavities firmly position and hold round or shaped bearings, which are popped into the receptacles. The material has excellent wear resistance, and in itself requires no lubrication, affecting savings in maintenance and downtime. Superior wear qualities and a wide temperature service are claimed to assure smooth, unhampered operation and greater bearing life.

Further information on glass-filled nylon bearing cages can be obtained by writing to the Garlock Packing Company, 442 Main Street, Palmyra, New York.

SECTION NEWS

BOSTON. . . . A special course in Practical Lubrication is currently being held at the Massachusetts Institute of Technology and is being sponsored by the Boston Section. Six sessions are scheduled on consecutive Mondays, the first of which was held on February 29. The planned sessions cover: Lubricant Properties, Tests, and their Practical Significance; Selection and Application of Lubricants; Lubrication Equipment; and a discussion on Planning a Lubrication Program. Registration in the course includes attending, as a guest, the dinner and regular monthly meeting of the Boston Section. All those attending the course sessions will receive copies of all talks and discussions, an engineering manual on lubrication and many other pieces of valuable literature. The course is being coordinated by the Education Chairman, Robert W. Tappin of the Morgan Construction Co. LOS ANGELES. . . . Regular February meeting featured a paper by E. P. Cunningham, Technical Service Manager, Petroleum Chemical Sales of Monsanto Chemical Co., St. Louis. The paper was entitled "Gear Lubricants for Today's Automotive Axles", and described the chemical method of function and the application of high performance gear lubricants to automotive axles. Slides and actual specimens supplemented the presentation. . . . NEW YORK. . . . In order to offer more information to members about other societies and their meetings and to aquaint others with the topics of ASLE meetings, the New York Section joined the Technical Societies Council of New Jersey. Meeting notices will be included in bulletins issued by the Council which will be mailed to all members. February 17 meeting was visited by J. D. Lykins of Wheeling Steel Co. and past president of ASLE, who gave a talk on the "Selection of Lubricating Devices.". . . ROCHESTER. . . . The subject of "Gears in General and Bevel Gears in Particular" was presented at the February meeting by Theodore F. Klem and Gilmore M. Spear of the Gleason Works. Representative samples of over 70 types of gears were shown to augment the presentation. . . . PITTSBURGH. . . . Program Chairman Robert C. Garretson introduced a novel half-hour discussion period at the January meeting. Called "What's Your Problem", it evoked much interest and lively discussion. It is planned as a part of the programs for the balance of the year.

PERSONALS

Raymond F. Burke has been appointed advertising manager of the Alemite and Instrument Division of Stewart-Warner Corp., succeeding F. R. Cross who has retired. Warren Coughlin has been named sales promotion manager for Alemite industrial lubrication products, and W. G. Peterson for automotive lubrication products and service equipment.

Appointment of Robert E. Sprow as division manager for lubricating equipment sales in the newly established Florida division was announced by the Aro Equipment Corp., Bryan, Ohio.

The Bunting Brass and Bronze Co. has named Harry G. Schwab to the position of director of manufacturing responsible for both the Toledo and Kalamazoo operations of the company.

Edward H. Ball of Chicago-Allis Mfg. Corp., has tendered his resignation as company president and assumed the duties of chairman of the board of directors and chairman of the executive committee. His son, Edward H. Ball, Jr. succeeds him as president.

The appointment of **Daniel F. Mahony** as assistant manager, lubricant development was announced by the Climax Molybdenum Co., a division of American Metal Climax. In his new position, Mr. Mahony will develop markets for the company's grease additives and promote technical and general sales lines.

Paul H. Richard, for the last five years automotive liaison representative of Du Pont's Petroleum Chemicals Division in Detroit, has been named head of a new automotive division in the company's Petroleum Laboratory. Succeeding him as Detroit liaison representative is Max W. Corzilius who has been attached to the Petroleum Laboratory as a research engineer.

Part of an overall expansion of Emery Industries includes the addition of H. G. Rodenberg, P. J. Kemper, and J. F. Morrow to the Research Department staff.

Lee Grimm has been appointed Western division sales manager of the Granberg Corp., subsidiary of American Meter Co., Inc. He will be responsible for sales and service operations in the Pacific Coast states.

The appointment of Russell W. Kenyon as general sales manager has been announced by the L. R. Kerns Company of Chicago. Mr. Kenyon has been associated with the company for sixteen years, serving as eastern regional manager for the past six years, and manager of the Detroit office prior to that time.

(Con't. on page 95)

1960 Report— How Baragel* and Baragel*24 improve grease efficiency

BARAGEL extends versatility as a non-soap gelling agent

Among the non-soap gelling agents used by grease compounders, BARAGEL has been coming to the fore as a versatile gelling material. Lubricating greases made with this product of Baroid Chemicals, Inc., show practically no change under extremes of heat, cold or moisture.

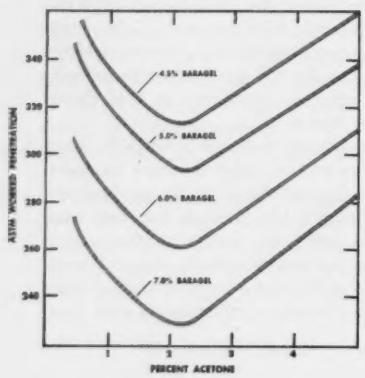
Technically, BARAGEL is a reaction product of mixed organic ammonium halides and refined sodium montmorillonite. A common organic antioxidant is included in the reaction mixture to provide built-in oxidation inhibiting properties.

As its chemical nature indicates, BARAGEL is a member of the BENTONE* family of products. BENTONE 34 has been outstandingly successful in lubricating greases, paint, plastics, inks and other fields. Experience indicated that even further efficiency could be achieved by tailoring the product to suit a specific application. BARAGEL is the result of research directed to make the product meet the needs of the lubricating grease industry.

BARAGEL efficient in greases made with high VI oils

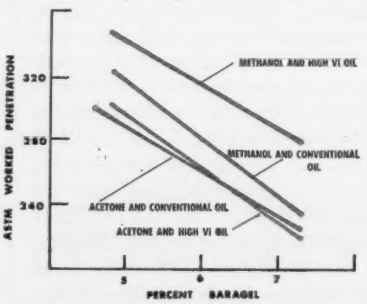
BARAGEL has proved to be efficient in greases compounded with all types of petroleum oils, including solvent refined, high VI oils. Tests were made with a base oil of 30.4° API gravity at 60° F and a viscosity of 356 SUS at 100° F.

BARAGEL was stirred into the oil, acetone added and stirred, and the mixture was milled. Greases having an ASTM worked penetration in the 315 range required about 4.5% BARAGEL, while greases in the 280 range required about 5.5% BARAGEL. Data Sheet A-1, available on request, gives full details of this test.



BARAGEL works efficiently with wide range of dispersing aids

As a grease gelling agent, BARAGEL works well in oils of low, medium or high viscosity, where the dispersion aid is either acteone or methanol. The influence of the dispersion aid may vary between different



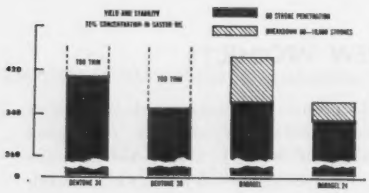
oils. The chart shown here illustrates the changes resulting from use of oils of varying viscosity.

It will be noted that the influence of acetone on yield at optimum concentration is essentially the same for both a conventionally refined oil and a highly refined, high VI oil. There is, however, a marked difference in the influence of methanol on yield at optimum concentration in the same two oils.

Complete details of a series of conclusions drawn from tests are available on BARAGEL Data Sheet A-8.

Greases made with castor oil

BARAGEL 24 has been proved by tests to be exceptionally efficient in thickening castor oil. Greases prepared with BARAGEL 24 are also much more stable to working in the ASTM grease worker.



Tests were made to compare results when thickening greases with BENTONE 34, BENTONE 38, BARAGEL and BARAGEL 24. The results are shown in the accompanying chart and details are available in Data Sheet A-5.

Worked penetrations of greases made with castor oil and 10% BARAGEL 24 were 325, with a penetration of 365 after working 10,000 strokes.

BARAGEL 24 improves efficiency in non-petroleum oils

Just as BARAGEL was the result of specialized research to make BENTONE 34 even more effective as a grease gelling agent, in the same manner BARAGEL 24 has been developed as an improvement over BARAGEL in thickening greases made with non-petroleum oils.

BARAGEL 24 works unusually well in compounding greases made from such non-petroleum oils as polyalkylene glycols, di-2-ethylhexyl sebacate, di-2-ethylhexyl adipate and castor oil. While BARAGEL 24 may not find widespread use in thickening most petroleum oils, it is possible that BARAGEL 24 may prove to be best for certain specific petroleum oils.

The improved efficiency of BARAGEL 24 in non-petroleum oils has been achieved primarily through the nature of the organic ammonium halide used. The inorganic portion of the product is refined sodium montmorillonite.

BAROID

BAROID CHEMICALS, INC.

A SUBSIDIARY OF NATIONAL LEAD COMPANY

1609 SOUTH COAST LIFE BLDG.

HOUSTON 2, TEXAS

PRODUCT LITERATURE

IMPERIAL PUBLISHES NEW HI-SEAL CATALOG

A new 44-page catalog which contains technical data and fully describes the complete Hi-Seal butt-joint fitting line is now available from The Imperial Brass Mfg. Co.

It contains over 250 additional styles and sizes. Also includes first printed material on Braze-Seal Fittings for extra high pressure and temperature.

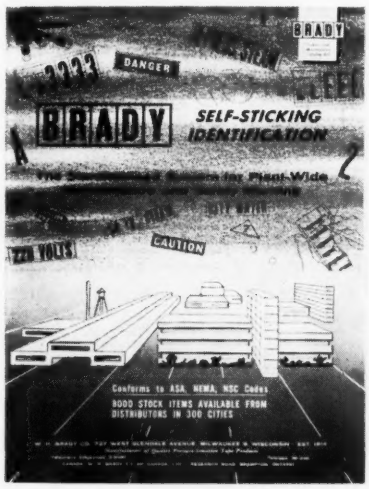
There are sections on pressure, vacuum, temperature, vibration, corrosion resistance, port seals, flow and velocity characteristics along with laboratory reports and complete assembly instructions.

Styles, sizes and materials of Hi-Seal stock items are listed in an easy-to-follow manner with complete dimension data on each type. Listing includes assorted fittings, valves, hose couplings and the special filter tee for continuous gas analyzation in chemical plants, refineries, hydraulic work and pneumatic systems.

Catalog No. 3108 may be obtained free from the Imperial Brass Mfg. Co., 6300 W. Howard St., Chicago 48, Ill.

CATALOG AIDS IDENTIFICATION PROGRAM

A catalog, featuring 15 different products to aid safety directors and maintenance engineers in planning, and executing industrial maintenance and safety identification programs in their plants is announced by W. H. Brady Co., Milwaukee.



Among the things covered in the publication are proper marking of piping systems, identification of plant wiring and electrical equipment, correct lubrication of machinery, and marking of hazardous plant areas and equipment. The system is standardized to universally accepted industry practices, and conforms to standards set up by the American Standards Assn., National Electrical Manufacturers Assn., National Machine Tool Builders Assn., and various government and military specifications.

A copy of the new catalog, with prices and free testing samples, will be sent free of charge to anyone responsible for plant safety or maintenance. Address: W. H. Brady Co., Dept. MS, 727 West Glendale Ave., Milwaukee 9, Wis.

HOSE AND FITTINGS CATALOG AVAILABLE

Industrial Catalog No. 204, containing descriptive information about hose, fittings, self-sealing couplings and related products, has been released by Aeroquip Corp.

The catalog includes complete, up-to-date specifications concerning Aeroquip products for use on general industrial applications such as plant machinery, mobile equipment, oil field machinery, stationary power plants, etc. It is available with either plastic binding or with a punched back for easy inclusion in parts counter record systems.

The general product categories covered in the catalog are: a complete range of hose types, fittings, adapters, self-sealing couplings, and miscellaneous items such as support clamps, protective sleeves, etc. A hose selector chart is included, listing the various applications for which specific hose types are recommended.

Write the Aeroquip Corp., Jackson, Michigan.

SYNTHETIC LUBRICANT FOR GAS TURBINES

A technical data report on Eastman synthetic lubricant ESL 3A, an ester-based fluid designed primarily for use in gas turbine aircraft, is now available from Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company.

ESL 3A is a qualified lubricant under military specification MIL-L-7808C, and is outstanding for its excellent storage stability and low coking panel ratings. Test data, detailed in the report, indicate that without stabilization, ESL 3A will retain its initial low coking panel and lead corrosion value even after two years storage.

The report also contains data on corrosion and oxidation stability, foaming characteristics, compatibility with other lubricants, and a complete list of physical properties.

Copies of the report (TDR N-108) may be obtained upon request to the company at Kingsport, Tennessee.

INSULATION BLANKET BULLETIN OFFERED

A new 4-page technical bulletin on "Insulation Blankets," containing results of thermal tests conducted by Electrofilm laboratories, has been released by Electrofilm, Inc., of North Hollywood, California. The thermal conductivity ("K" values) of various metals, insulating materials and other miscellaneous materials such as: air, gases, rubber, etc., are listed. The technical bulletin explains a simple method of calculation, especially useful in determining both the thickness and kind of material to be used in insulation of a given part and the amount of heat necessary to maintain any specified bulk temperature of that part.

This technical bulletin, #6019, "Custom Insulation Blankets," is available from Electrofilm Technical Service, 7116 Laurel Canyon Blvd., North Hollywood, California.

PERSONALS

(Con't. from page 93)

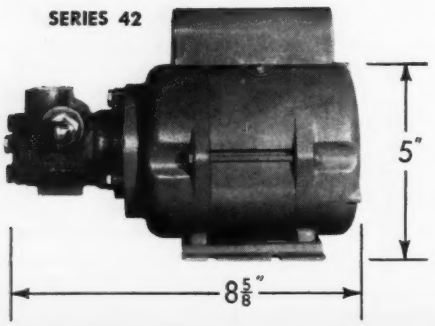
Raymond T. Zwack has joined the Liquidometer Corp., as manager of industrial products and systems development. He will be responsible for the design and development of instrumentation and control systems as well as other products for industrial application.

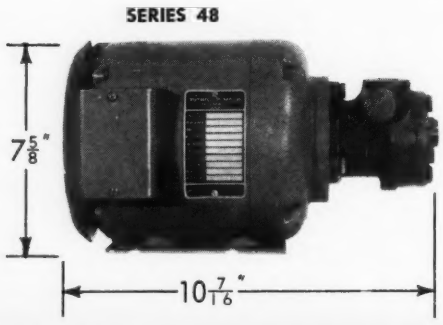
In a series of promotions and reclassifications, J. Marvin Larkin was named director of advertising and public relations of Micro-Lube of Dallas. John M. Shelnutt has been promoted to sales manager of the company's oil field division.

Royal Lubricants Co. announces the promotion of **James C. Mosteller** from vice president of research and development to executive vice president; and Oliver M. Ballentine from chief chemist to vice president of research and development. Mr. Mosteller is the firm's representative to ASLE.

Appointment of Edward W. Preston to the post of central region market analyst was announced by SKF Industries. In his new capacity, Mr. Preston will be responsible for gathering regional market research information and aiding in the analysis and development of sales programs.

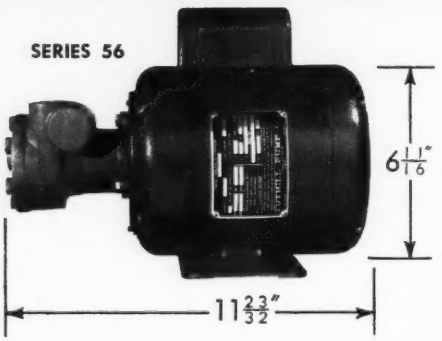
The Timken Roller Bearing Co. has named R. L. Frederick to the new position of executive-director, International Division. He will be mainly concerned with manufacturing in overseas locations, with special emphasis toward coordinating methods and programs.





SAVE SPACE...WEIGHT...MONEY

with TUTHILL close-coupled pump and motor combinations



Tuthill close-coupled pumps and motor combinations are especially designed for applications where space is at a premium. Their compactness simplifies assembly operations and lowers production costs. Elimination of couplings, bases and adapters results in significant savings . . . and reduced weight means lower shipping costs.

Tuthill offers a complete selection of units with capacities up to 50 GPM for pressures to 500 PSI. A wide variety of special options is also available. Three standard units are pictured above.

Immediately available from stock

The series 42 units measure only 5"x8 5/8". Their total enclosed ballbearing motors are normally supplied with ratings from 1/12 to 1/6 HP while the pump units have capacities of 20 to 45 GPH at 200 PSI.

Series 48 units, measuring 7 5/8"x10 7/16", are normally supplied with totally enclosed, fan-cooled motors of either split phase, capacitor, or 3 phase construction . . . with ratings from 1/4 to 1/2 HP. They can be supplied with pumps with capacities from 20 GPH to 360 GPH at 200 PSI.

Series 56 units measure 6 11/16"x11 23/32", and are offered in a complete range of motors varying from 1/4 to 1 HP. These can be coupled with pumps with capacities from 20 to 360 GPH at 200 PSI.

Although motors are normally furnished for 1725 RPM they are also available for 3450 and 1140 RPM. Explosion proof construction and double shaft extensions on motors are also furnished in series 48 & 56. Built-in relief valves are optional on all five pump sizes.

Special construction for OEM applications

The units shown plus others in Tuthill's line are immediately available without any quantity restrictions whatsoever.

For those original equipment applications involving substantial quantities, Tuthill's engineers can design and build a POWERMITE . . . an exclusive Tuthill design in which pump and motor are combined in one unit which takes up no more space and weighs no more than a standard electric motor. As an example of the compactness possible a Tuthill POWERMITE now being supplied for a hydraulic application measures only 4 3/4"x8 1/16", yet has a capacity of 16 GPH at 350 PSI.

Tuthill's field engineers will be happy to provide details on the complete Tuthill close-coupled line and its application to your particular problem. If you are trying to fit a pump and a motor into a tight space you should talk to them soon. Call today.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 GPM; for pressure to 300 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

971 East 95th Street, Chicago 19, Illinois

LETTERS TO THE EDITOR

Lubrication Engineering welcomes the comments and suggestions of readers with regard to articles published in its pages or concerning topics of interest to those engaged in any phase of lubrication engineering. Letters received cannot be acknowledged, but those felt to be of interest to other readers will be published. The Society will not be responsible for the statements or opinions expressed.

Sir:

Please help me out—I'm in an awful quandary!

The cover of the May 1959 issue of LUBRICATION ENGINEERING shows, "The 5 R's of Lubrication"—the right lubricant, in the right quantity, at the right price, at the right time (sequence here is NOT right). Turning to page 201 (same issue) "time" gets lost in the first paragraph. Maybe that's what we sometimes run out of!

At the 1959 ASLE Annual Meeting, Buffalo, N.Y., I heard a paper presented on the lubrication of small mechanisms and the author talked about 4 r's—I don't rightly know which one he left out, however, that wasn't too bad—that's his right.

But now I pick up a copy of the house organ LUBRICATION, December, 1959 and lo an' behold—we hit 6 r's! The newest addition to the "r" family is "right condition." This has to do with lubricants being destroyed through improper storage and handling. (It should also be considered for the one applying the lubricant).

Not to be outdone by LUBRICATION ENGINEERING and LUBRICATION, I'd like to introduce a 7th "r" or right—the right machine! As we often get to work early in the morning and our eyes are drooped from watching the one-eyed monster, or the boys at the local pub wouldn't let us go home, or the youngest tot had the colic—all the "r's" in the world don't do any good if we don't end up putting this lube in the right machine. So, I think we should come up with 7 r's in the following order:

the right lubricant
in the right condition
in the right quantity
in the right machine
at the right price
in the right place
at the right time

Does anybody have any more "r's"? Maybe we can reach the old advertising slogan of a well-known food processing company—57 varieties. Let's try and see if we can't come up with 57 "rights." The one submitting the 57th ought to be entitled to an ASLE Lapel Pin—right?

Very truly yours,

Millwright

P.S. Please withhold my name on request. My boss doesn't think I have the right to write letters on company time.

Ed. Note.

You're right! Everyone has a right to his rights.

don't forget to attend the 1960 ASLE Annual Meeting

April 19, 20, 21

Netherland-Hilton Hotel

Cincinnati, Ohio

The Annual Education Course Program is listed on page 120 of this issue.

LOOK FOR—

"The Lubrication Engineer in Action"

in the April issue of—

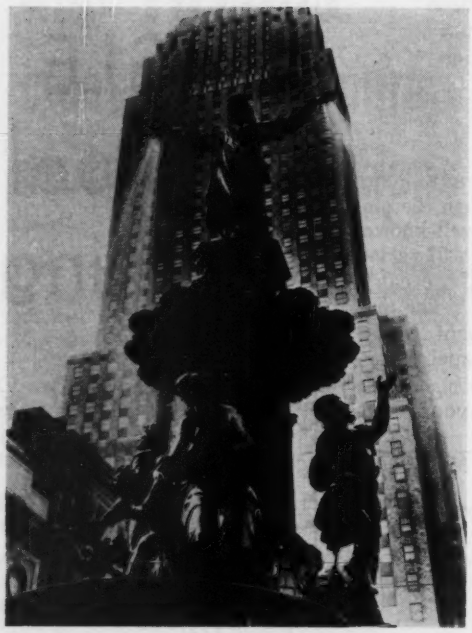
Lubrication Engineering

It's Cincinnati

This year, Cincinnati, the city of seven hills will be host to the ASLE members and visitors who will attend the 15th ASLE Annual Meeting and Lubrication Exhibit.

This year's program reflects more than ever the broad interests of the Society. The National Program Committee, with the help of the technical committees and industry councils, has provided an outstanding group of authors to present technical papers covering the many aspects of lubrication. As a result, there is much of interest planned for all who attend.

In addition to the technical sessions, there will again be an education course for those desiring to further their knowledge of fundamental lubrication practices. These courses, sponsored by the Education Committee, are specifically designed to cover various fundamentals in the field of lubrication. They have, in the past, been well received and this year is expected to see a greater than ever registration.



Leading manufacturers of lubricants and lubricating devices will display their products in the Lubrication Exhibit which will be open to all. This annual feature of the meeting has become the market place for new developments and trends in lubricants, application devices and other products related to lubrication.

To open officially the 1960 Annual Meeting, the Cincinnati Host Section has planned a Welcoming Party to be held on Monday, April 18th at 7:00 p.m. All ASLE members are invited to attend.

Members are encouraged to bring their wives to the Annual Meeting. To make their stay in Cincinnati more pleasant and interesting, a special Ladies Program has been planned. Featuring tours of the city, luncheons, and an extra special feature of a cruise on the Ohio River on the Johnson Party Boat, the Ladies Program is bound to be enjoyable.

Welcome to Cincinnati!

Cincinnati by day (top) and Cincinnati at night (bottom) offers the visitor some breath-taking views. The center photo shows the world famous Tyler-Davidson Fountain with the Carew Tower in the background, both well known landmarks in the city of seven hills.

in April...

The National Program Committee and the officers of the Cincinnati Host Section invite you to attend the 15th Annual Meeting and Lubrication Exhibit of the American Society of Lubrication Engineers. This year, as every year, men whose livelihood is based on their knowledge of the latest trends in the field of lubrication will find this the open door to increased awareness of new developments and practices in their chosen profession.

Highlight of the three days of important technical meetings and activities will be the annual meeting banquet on Wednesday, April 20. This year, as every year, old acquaintances will be renewed as friends meet on a social basis. Tickets will be available at the registration desks, so plan to get yours when you register. And remember, guests are invited. The Cincinnati Host Section has arranged to have the Cincinnatians and the inimitable George Bailey entertain you and help make your evening a happier one.

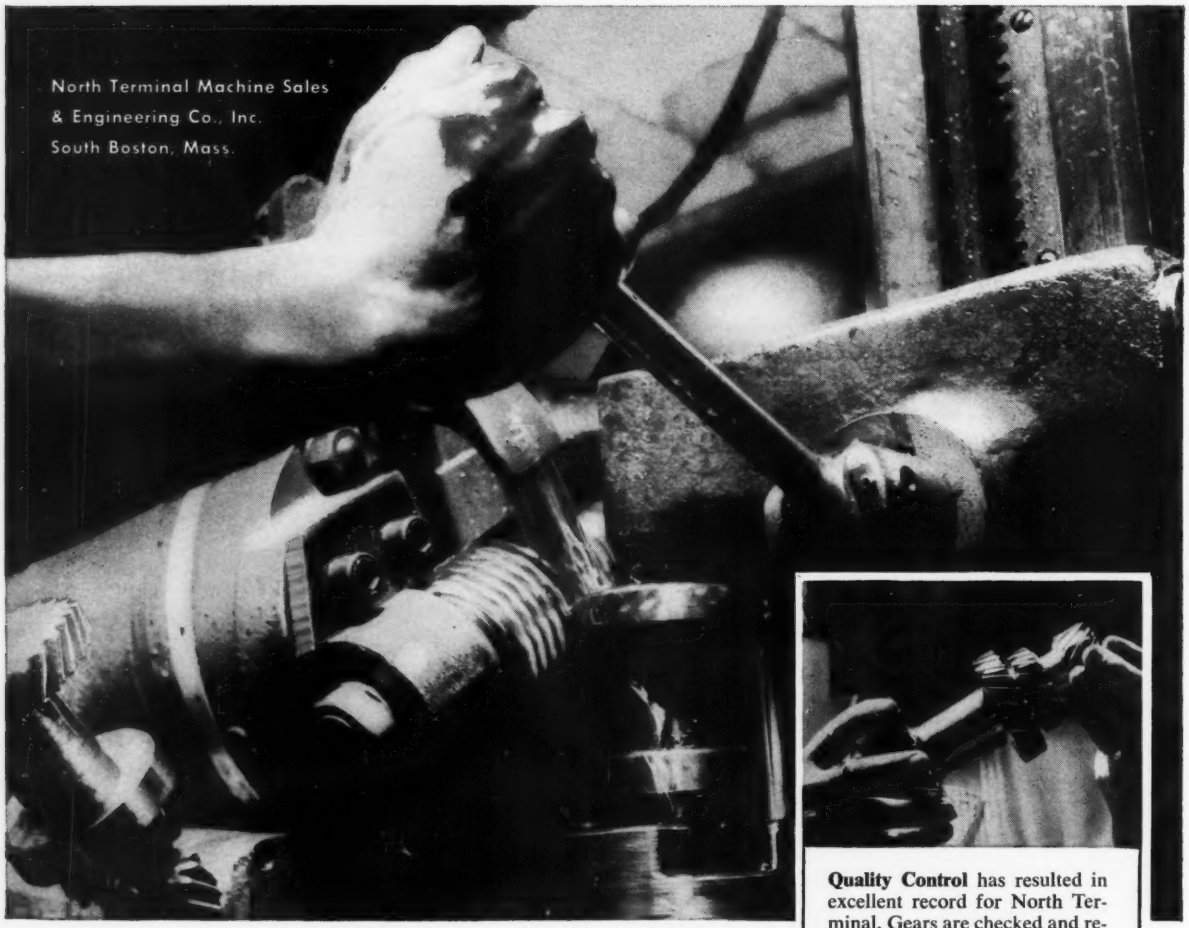
This 60 voice chorus is Cincinnati's largest and most colorful male Glee Club. It is a non-professional civic group, comprised of men from all walks of life who enjoy singing, and participate in this activity as a hobby. In their bright "fox hunt red" coats, this group makes an eye-catching appearance and their rousing male voices promise to delight and hold the attention of listeners.

Few entertainers can equal George Bailey's versatility. Memory expert . . . magician . . . and musician . . . this triple threat performer promises something different in the way of a fun-filled evening. His photographic mind has been acclaimed by all who have seen him, and the melodies played in four-part harmony on a set of imported musical glasses will be something to hear. All this plus some mixed-up magic promises a delightful evening's entertainment.

1960 ASLE NATIONAL AWARD PRESENTATION. . . .

This year's ASLE National Award will be presented to John Boyd at the Annual Meeting Banquet on April 20. Mr. Boyd, Manager of the Bearing and Lubrication Section of the Westinghouse Research Laboratories in Pittsburgh, was chosen to be the recipient of the highest honor bestowed upon an individual by the Society. The award symbolizes an honorary life membership in ASLE and is made in recognition of an outstanding contribution to the field of lubrication. Mr. Boyd's many important contributions in the field of hydrodynamic lubrication qualify him to be named the outstanding man-of-the-year in this field. He is widely known as an authority on hydrodynamic lubrication and has authored numerous papers on the subject. Recently, he has taken a leading part in developing bearing design methods based on computer solutions of the fundamental hydrodynamic equations.

Mr. Boyd is currently serving as Editor of LUBRICATION ENGINEERING and ASLE Transactions. In addition to other important offices in the Society, he served as ASLE President during 1954-55.

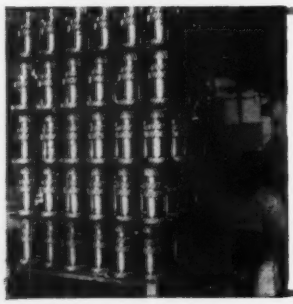


Quality Control has resulted in excellent record for North Terminal. Gears are checked and rechecked after each step in production. Quality lubricants have helped hold to close tolerances.

Hob Life Increased 250% with Cities Service Chillo 10 Cutting Oil

North Terminal makes replacement gears for automobile transmissions. In a day's time the firm—which makes the gears from raw stock to finished product—completes up to 5600 gears. Producing in quantities like this, hob life is an important consideration in *cost* of production as well as *quality* of production.

Previous cutting oils were tested on the gear hobbing machines and they resulted in hobs producing as low as 87 gears before replacement. Cities Service Chillo 10 cutting oil under the same conditions resulted in over 200 gears with a superior finish before a hob replacement was necessary.



5600 Gears per day or the equivalent of 800 replaced transmissions are produced every day by North Terminal. Gears are made for all makes of cars with a good portion of production being shipped overseas.

Edward W. Malley Jr., President of North Terminal, states, "We didn't choose Cities Service cutting oil blindly. Many competitive oils were tested before we were satisfied that Chillo 10 was superior in every way."

Even if you're satisfied with your present cutting oil, a test of Cities Service Chillo 10 may give you a very pleasant surprise. Test after test under actual manufacturing conditions has shown Chillo 10 to give longer tool life and superior finishes.

Arrange for your own test by calling your nearest Cities Service office or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Vol. 16, No. 3

Lubrication Engineering

to know ourselves . . .

. . . and have others know us is ASLE's greatest need today. Despite the vital importance of lubricants and lubrication in every phase of industry, relatively few management groups comprehend or concede the value of a specialized engineering approach to the problem.

Even within our own circle, the function and goals of a lubrication engineer are neither well defined nor clearly set forth in terms of promised accomplishment.

Yet, the future of lubrication engineering is clear and bright. Recognition is sure to come, special curricula will be established at leading technical schools and company organization charts of the future will be incomplete without some provision for lubrication engineering. The tremendous need for careful attention to lubrication, in all phases of industrial design, production and operations, makes this certain.

To hasten this natural growth and development of our specialty, we will publish the first of a series of reports entitled, "The Lubrication Engineer In Action," next month. Each will deal with the activities and accomplishments of a specific individual in a specific situation.

It is *not* the intent of these reports to establish a pattern, or set up standards for the practicing lubrication engineer. Rather, we hope that these reports will prove a valuable guide in finding new ways to serve—and perhaps also that they will be attended by those in a position to bring the inevitable future of lubrication engineering into present being.

Watch for Report No. 1 next month!

J. Boyd
Editor

A Survey of Lubrication Methods

by Allen F. Brewer*
Consulting Editor

Illustrated by Robert R. Wayne
Pittsburgh, Pa.

Considerable care is usually exercised in choosing the oils and greases which are required to lubricate machinery; sometimes, however, less attention is given to a consideration of the method by which the lubricants are applied. The method which is used, the devices by which the lubricant is applied and the manner in which the device is installed, all contribute greatly to the efficient and economical lubrication of the machine and should be a primary design consideration, not an afterthought.

The time has long passed when the mere fact that a machine would run was considered sufficient reason to justify the lubrication method used. Today the demands are much more exacting. The lubricating device or method selected must be economically compatible with the equipment to be lubricated, both in initial cost and in subsequent maintenance expense. In many applications contamination of the product by the lubricant must be avoided, thereby imposing a further restriction on the lubricating device. The necessity of selecting and incorporating lubricating devices in a manner conducive to personnel safety and good housekeeping is becoming more and more appreciated.

Each class of lubricating device has an area of application for which it is best suited. There is no one method or device that is best suited for every type of service. The conclusion that one device may be employed to better advantage in a particular situation than some other device, does not preclude the probability that the relative merit of the two devices will be reversed in some other application.

In order to make a logical choice of the most suitable lubrication method or device for a particular application, a knowledge of the physical design and basic characteristics of each is necessary.

The objective of this discussion is to assist in the proper selection and application of lubricating devices by providing a description of the various types and by indicating their pertinent characteristics. Some general considerations associated with incorporating such devices into the overall design of a machine also are discussed along with typical service application for the various types of lubricators.

The treatise is composed of three sections.

In the first, the characteristics to be considered in evaluating lubricating devices and the factors related to incorporating them into an overall design are discussed.

In the second section the methods for lubricating machine elements are generalized into several categories and the basic characteristics presented in the first section are discussed for each category, with indication of typical service applications.

The third section is a compendium of lubricating devices, presented, with the aid of suitable illustrations, to acquaint the reader with the physical construction and operation of the various devices available for lubrication.

It is not within the scope of this article to consider the design of bearing elements or to make specific recommendations as to the quantity or type of lubricants.

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* Consultant and author "Basic Lubrication Practice."

Editor's Note: Believing that there is a need for a unified treatment which would assemble the scattered and diverse information on lubricating methods, the Society commissioned Allen Brewer to prepare a comprehensive review of the methods by which lubricants are applied. In a series of articles, of which the above is the first, the pertinent characteristics of the different methods will be discussed and, through the liberal use of illustrations by Robert Wayne, the various lubricating devices will be described. The preparation of the articles was greatly facilitated by the cooperation of a number of suppliers and users of lubricating equipment.

Part 1--
Characteristics of Lubricating Methods

In order to evaluate a particular method for a specific application, there are certain characteristics which should be considered. For the purposes of this treatise, the following criteria for evaluation have been defined which can serve as a check list to aid in the selection of lubricating devices. Any given criterion may, of course, be of more or less importance depending on the particular application.

The first group of characteristics relate to the delivery of lubricant.

DELIVERY OF LUBRICANT

Regulation. . . . Too much lubricant can often be just as harmful as too little. The lubricating device should have a degree of feed or flow regulation suitable for the intended application.

"What do you mean lubrication problem? We've never had a bearing fail!"

Adaptability. . . . In some applications the operating conditions for the machine may vary. Often an increase in speed may require an increase in the amount of lubricant supplied. The lubricating device is considered adaptable if it adjust or adapts its rate of lubricant supply to the demand.

Uniformity. . . . Uniformity relates to the ability of a device to supply lubricant at the intended rate over long intervals of time without requiring adjustment. For example, systems in which changes in oil level with time cause an appreciable change in the rate of feed are not considered to possess uniformity.

Continuity. . . . This refers to the manner in which the lubricant reaches the area to be lubricated. The same quantity of lubricant can be delivered in a given time interval either by drop or else at some continuous rate of flow. Continuity of delivery or continuous delivery avoids feast and famine conditions in a bearing.

RELIABILITY

In addition to supplying the lubricant in the correct manner and in the right amount in accordance with the operating conditions, the device must be reliable. The following are influencing factors which relate to reliability.

Human element. . . . Any lubricating method or device that depends in whole or in part on human action will only be as reliable as the individual operator. The extent to which reliability can be influenced will depend on the sort of action required by the personnel. Functions that require judgement on the part of the operator as to the amount or frequency of lubricant application are more subject to error than those where the operator simply maintains an oil level in a reservoir and the amount and the interval of lubrication is controlled mechanically.

Automatic operation. . . . A lubricating device is considered to be automatic when it is actuated by the machine to be lubricated, starting and stopping the flow of lubricant as the machine starts and stops. In general, automatic devices increase reliability by eliminating an important possibility for human oversight.

Positive operation. . . . A device will be classed as positive if it is capable of developing an appreciable pressure on the lubricant when it becomes necessary for the lubricating system to purge itself of any restriction that might cause clogging or otherwise impede the flow of lubricant to the bearing element.

A lubricating device should be rugged enough to withstand any mechanical shocks or rough treatment that might be reasonably expected to occur during service.

Avoid Lubricant Contamination!

Contamination resistance. . . . The degree to which a lubricating device can resist contamination of its contents from dirt in the environment to which it is subjected can influence reliability in several ways. Dirt clogged lines or valves can prevent the device from operating, even to the extent of stoppage of flow of lubricant; or, if dirty lubricant does get by, the abrasive nature of the contaminant could cause serious damage to bearing surfaces. Excess dirt also can obscure the device from view possibly causing it to be overlooked by the maintenance personnel.

COST CONSIDERATIONS

In addition to supplying lubricant in a correct and reliable manner, the device selected must be justified economically.

Initial cost. . . . The initial cost of a lubricating device can usually be readily determined. On the other hand, the advantage of low initial cost can often be neutralized if the application is such that high maintenance costs will follow.

Maintenance cost. . . . The most obvious maintenance expense is the cost of labor in operating and servicing a lubricating device. This cost will depend on the number and location of the points to be lubricated, and the frequency with which they require an operator's attention. The cost of lubricant also must be taken into account. This can assume a high degree of prominence if the lubricating device is particularly wasteful. Another relatively obvious maintenance expense is the cost of replacing parts damaged due to malfunctioning of the device either through mechanical difficulties or human error. A somewhat less obvious but very real expense is the loss of production due to down time in lubricating or repairing a machine. In some cases breakdown on one machine in a production line will idle others, thus compounding the cost.

OVERALL DESIGN CONSIDERATIONS

The characteristics discussed thus far are mainly inherent properties of lubricating devices that do not lend themselves readily to modification by the machine designer. There are other factors, however, that are within his control. These factors, which involve the care and thought with which the lubricator is incorporated into the overall design, can have a decided influence on the ultimate utility and performance of the lubricating system as a whole.

Safety and Accessibility are Important Too!

Accessibility. . . . In spite of precautions to prevent entry of dust and dirt, all lubricating devices require periodic cleaning. In addition, many have reservoirs which must be refilled periodically. Depending on where the designer locates the device and the provisions for ready access, the result can be either a headache or an efficient, easy to maintain system.

Safety. . . . This goes hand in hand with accessibility. Safety is equally as important in lubricating a machine as it is in operating one. If the designer fails to consider safety in laying out his design, it is possible that either subsequent lubrication of the operating machine will be hazardous or else that the unit will have to be stopped to permit safe lubrication. Neither situation is desirable.

(*Con't. on page 128*)

The removal of heat from bearing surfaces is a function of the heat capacity and thermal conductivity of the lubricant. Intelligent equipment design requires a knowledge of these properties. This paper describes a rapid method of measuring heat capacities over an extended temperature range. The design and operation of a simplified semi-adiabatic calorimeter, and a unique method of calculation are outlined. With this system of measurement, heat capacities are obtained with less than 5 per cent error.

Rapid Determination of Heat Capacity of Liquids Over Extended Temperature Ranges

J. W. Barger, C. C. Bolze, R. L. Hughes and T. M. Medved
Midwest Research Institute
Kansas City, Missouri

The primary purpose for lubricating surfaces such as bearings is to minimize the conversion of mechanical energy to heat by reducing the friction. Theoretically, the perfect lubricant would prevent the conversion of any mechanical energy to heat. Since the perfect lubricant does not exist, an appreciable amount of heat is created in moving surfaces.

In addition to this unavoidable generation of heat, jet and rocket propulsion systems have created much higher operating temperatures. The higher velocities obtained from these propulsion systems have raised an added heat problem (aerodynamic heating) in auxiliary equipment. Thus, these high heat loads have focused attention upon lubricant thermal properties.

The design of equipment operating at high temperatures requires a knowledge of both the heat capacity and thermal conductivity of the lubricant. The amount of heat removed from a bearing by a given amount of lubricant is a direct function of the lubricant's heat capacity and the temperature differential. In general, the literature does not contain the necessary high temperature data to make these calculations. Data on recent modifications of the petroleum base lubricants and the new synthetic lubricants are completely lacking.

The large number of possible high-temperature lubricants and hydraulic fluids makes the rapid screening of thermal properties more important and desirable than extreme accuracy. Most methods described in the literature (1,2) were designed for high precision, and sacrifice speed of measurement for precision and accuracy. Specifically, in the petroleum field several workers (3,4) have devised schemes for measuring heat capacity, but most of their methods require larger samples and more time. Other investigators (5, 6) have been largely concerned with the correlation of heat capacity with A.P.I. gravity, temperature, and the petroleum characterization factor.

Presented before the 14th ASLE Annual Meeting, Buffalo, New York, April, 1959.

This paper describes a method of rapidly determining the heat capacity of oils, lubricants, fuels, or hydraulic fluids over an extended temperature range. The fluids may be petroleum-based or pure synthetic materials to which generalized petroleum equations are not applicable. Unique calorimeters have been designed for the rapid determination of heat capacity up to 500 F with an accuracy of 5 per cent or better. For example, with this equipment, the heat capacity at five temperatures spanning the ambient to 500 F range can be determined in 6 hr. To maintain required precision, the order of the measurements was established statistically and each sample was measured in duplicate by alternate calorimeters.

EXPERIMENTAL

A. *Equipment*

The components of the calorimeter are illustrated in Fig. 1. The various parts as identified by number are: cold trap (I), Dewar (sample holder) (II), mercury reservoir (III), Dewar top and stirrer motor (IV), sample heater (V) and stirrer (VI). The in-

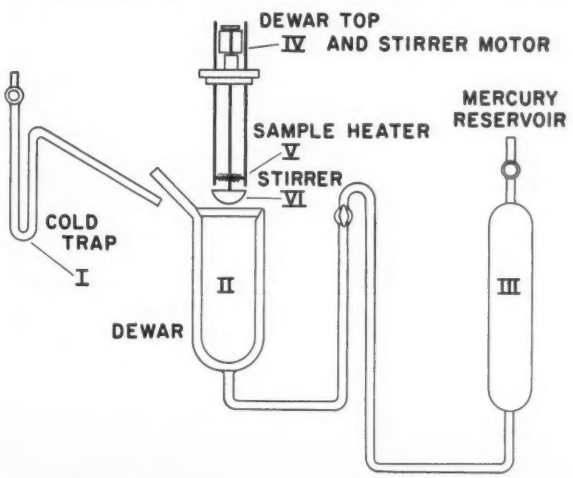

Fig. 1. Calorimeter

dividual calorimeters are constructed of heat-resistant glass. Metal straps are used to attach and support the glassware. The volume of the Dewar portion is about 250 ml., and the volume of the mercury reservoir is about 150 ml. The connection from the Dewar jacket to the reservoir consists of 2-mm. diameter tubing and a 2-mm. stopcock to provide complete transfer of the mercury from the Dewar jacket into the reservoir. The bore of the stopcocks on the cold trap and the mercury reservoir is not critical.

The Dewar top is constructed from pressed asbestos insulating board. It serves as a cover and as a support for the motor-stirrer and sample heater. The sample heater is approximately a 140-ohm element formed by winding No. 32 B & S gage nickel-chromium wire on a porcelain base. The heater element is connected to copper leads enclosed in glass tubes. After the electrical connection is made, the glass tubes and heating element base are sealed with ceramic cement. The stirrer is a flat half-circle piece of stainless steel, which is connected through a reduction gear to the 6 v. DC motor.

The heater energy is supplied by a constant voltage transformer. The potential (about 14 v.) and the electrical current (80 to 140 ma.) supplied to the heater are read to the nearest 0.01 v. and 0.001 amp. An electrical timer, reading to the nearest 0.1 sec., is used for determining the necessary time intervals. The temperature of the sample is measured with a Fiske differential thermometer (thermistor type). The sensitivity of this instrument depends upon the temperature range. The minimum detectable temperature changes are ± 0.002 F at low temperature and ± 0.006 F high temperatures. An oil pump is used to obtain a vacuum of about 10^{-3} mm. Hg on the Dewar jacket.

To shorten measurement time, four calorimeter units as illustrated in Fig. 1 were constructed. These units are mounted in a large thermostat, which is equipped for constant temperature control over the 70 to 500 F range.

B. *Procedure*

A sample (about 100 ml.) of the test liquid was accurately weighed into the Dewar and the top-stirrer-heater unit set in place. When the large thermostat had reached the selected measurement temperature, the calorimeter unit was lowered into the thermostat. The stirrer was started and the temperature sensing probe was inserted. The mercury in the Dewar jacket rapidly equalized the sample temperature to that of the thermostat. At this point the mercury was pumped to the reservoir, the cold trap was attached to the Dewar and immersed in liquid nitrogen, and the Dewar jacket was evacuated. The expansion of the gases and evaporation of residual mercury in the Dewar jacket always resulted in a fast sample temperature change of 1 to 2 F. To avoid errors from this initial heat transfer, no measurements were started until 2 min. after applying vacuum. Experience showed that after this 2 min. equilibration period the heat transfer from the calorimeter was slow and uniform.

Starting with zero time (2 min. after applying vacuum) the following operations were performed and the data recorded. Thirty seconds—sample temperature recorded; 100 sec.—sample temperature recorded and heater turned on; 130 sec.—sample temperature recorded; 140 sec.—voltage and current recorded; 220 sec.—same as 140 sec.; 230 sec.—sample temperature recorded and heater turned off; 260 sec.—sample temperature recorded; and 300 sec.—sample temperature recorded.

There were three reasons for strictly adhering to this order of measurement. First, the calorimeters were not absolutely adiabatic but exhibited a slow linear heat loss. This rate of heat loss was low and a function of temperature. The rate of heat loss as measured by temperature decrease was 2 to 4 F per hour for low temperatures and 16 to 18 F per hour at high temperatures. Secondly, there was a small lag time in the temperature measuring equipment. Thirdly, the rate of temperature change was used to calculate the heat capacity.

C. *Calculations*

By assuming that temperature equilibrium is achieved rapidly and that the heat loss rate (dH/dt) is constant for a given system at a given temperature, the following equation is applicable over a limited range:

$$\text{Net heat loss} = \int_0^t \left(\frac{dH}{dt}\right) dt = B_c\ \Delta t(W_sC_s + W_cC_c) \qquad [1]$$

where (B_c) is the temperature loss in Fahrenheit degrees per second; (W_s) and (W_c) are the weights of the sample and calorimeter components, respectively; (C_s) and C_c) are their respective heat capacities per unit weight and (Δt) is the time in seconds.

Likewise, the net heat gain can be expressed as:

$$B_h\ \Delta t(W_sC_s + W_cC_c) \qquad [2]$$

where (B_h) is the temperature rise in Fahrenheit degrees per second.

The total heat put into the system will equal the sum of the gain and loss; thus:

$$EI\ \Delta t = B_h\ \Delta t(W_sC_s + W_cC_c) + B_c\ \Delta t(W_sC_s + W_cC_c) \qquad [3]$$

or

$$EI\ \Delta t = (B_h + B_c)(W_sC_s + W_cC_c)\ \Delta t \qquad [4]$$

where (E) is the potential applied to the heater and (I) is the current through the heater.

Solving Eq. [4] for the heat capacity of the sample yields:

$$C_s = \frac{1}{W_s}\left[\frac{EI}{B_h + B_c} - W_cC_c\right] \qquad [5]$$

The weight of the sample (W_s) and the energy input (EI) are measured directly. The rates of temperature rise (B_h) and loss (B_c) are determined from the sample temperature readings described in the previous section. The value of the calorimeter term (W_cC_c) is determined with a standard of known heat capacity. In this work the standard chosen was diphenyl ether which had been purified by recrystallization. The heat capacity of diphenyl ether has been accurately determined over a wide temperature range (7,8).

DISCUSSION AND RESULTS

The heat capacities of 32 liquids consisting of mineral and synthetic engine oils, lubricants, fuels, and hydraulic fluids were determined. Prior to the start of measurements, a statistical design was prepared to provide randomization of samples and minimization of sample instability effects. Randomization of the samples is desirable to avoid personal bias. Also, some of these materials were subject to thermal decomposition, and the experimental design was used to minimize the errors from this source. The fluids were assigned random numbers and the order of measurement in respect to temperature was 284, 464, 104, 176, and 392 F.

Four determinations were made on each fluid at each temperature. The measurements were then duplicated with fresh samples in different calorimeters. Therefore, there were eight determinations for each temperature.

Computation of calorimeter constants was achieved by running diphenyl ether in each calorimeter twice. This gave 32 readings at each temperature point for a base line calorimeter correction. These values, in conjunction with the data from the 32 oils (each run in two calorimeters), enabled the calculation of individual calorimeter corrections from this base line correction fairly precisely. The calorimeter constants and the 95 per cent confidence limits determined by this method are shown in Table 1.

TABLE 1. CALORIMETER CONSTANTS

TEMPERATURE, °F	CONSTANTS, BTU/°F			
	CALORIMETER #1	CALORIMETER #2	CALORIMETER #3	CALORIMETER #4
104	13.74 ± 0.94	15.01 ± 0.94	14.63 ± 0.94	15.08 ± 0.94
176	15.38 ± 0.66	16.50 ± 0.66	15.68 ± 0.66	16.05 ± 0.66
284	17.24 ± 0.49	18.51 ± 0.49	16.57 ± 0.49	17.77 ± 0.49
392	18.51 ± 0.66	19.56 ± 0.66	17.02 ± 0.66	19.48 ± 0.66
464	18.81 ± 0.94	19.86 ± 0.94	17.17 ± 0.94	20.60 ± 0.94

Typical values of the heat capacity results obtained are shown in Table 2. The values given in this Table are averages of eight determinations at each temperature. These data are shown graphically in Fig. 2.

The dependence of heat capacity upon temperature for the three fluids is given by the following equations:

$$\text{Fluid A} \quad C_p = 0.3491 + 5.315 \times 10^{-4}t \qquad [6]$$

$$\text{Fluid B} \quad C_p = 0.2408 + 3.151 \times 10^{-4}t \qquad [7]$$

$$\text{Fluid C} \quad C_p = 0.3521 + 5.064 \times 10^{-4}t \qquad [8]$$

These equations are of the same form as those presented by Fallon and Watson (6) for light hydrocarbon gases. These workers use the absolute temperature scale and included a third term (second power of temperature). The equations presented here are based on the Fahrenheit temperature scale. The third term was eliminated because it was not needed to maintain the required 5 per cent accuracy.

TABLE 2. MEASURED HEAT CAPACITIES

TEMPERATURE °F	HEAT CAPACITY, BTU/LB/°F		
	FLUID A	FLUID B	FLUID C
104	0.409	0.260	0.404
176	0.443	0.312	0.438
284	0.491	0.335	0.504
392	0.561	0.360	0.550
464	0.598	0.385	0.585

Note: Fluid A is tribenzyl n-hexadecyl silane.
Fluid B is Di (α −H, α H, ω −H perfluoroalkyl) camphorate.
Fluid C is a petroleum based oil.

The lines shown in Fig. 2 were calculated by the least squares method. Lines for Fluids A and C are almost the same and appear as one line in this plot. In this calculation, the heat capacity was assumed to be a linear function of temperature over this range. This assumption appeared to be acceptable when the standard errors were calculated. The computed error term is based upon the deviations from linearity and consequently is greater than the actual precision. This error term contains the variance of replicate measurements, time effects, sample decomposition and sample loss, and any curvature in the heat capacity lines. In spite of this gross pooling of error components, the standard error (or precision) of the least squares estimate at a given temperature remained ± 0.017 Btu/lb/°F or less over the temperature range. The errors found for the least squares values (based on the determinations of 32 fluids) are shown in Table 3.

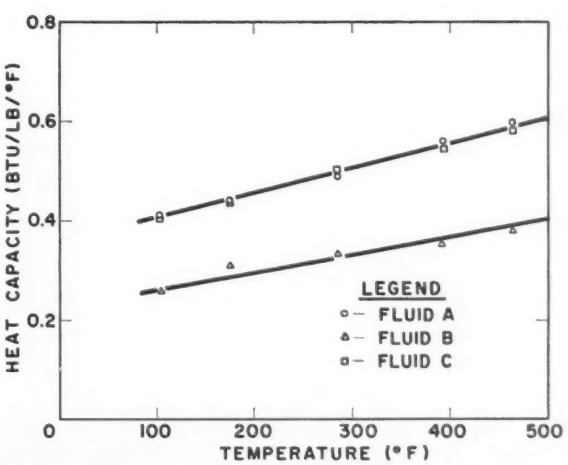

Fig. 2. Heat Capacity

(Con't. on page 118)

Predicting Grease Performance from Capillary Viscometry Data*

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While it is convenient to compare different greases on the basis of rheological data obtained by capillary tube viscometry, the results are not always correlatable with actual grease performance in large scale centralized lubrication systems. For example, Miller and associates (1) measured the flow properties of a series of commercial and experimental greases using various capillary lengths-to-radius (L/r) ratios. They observed pronounced differences in viscosity in these varied length conduits over a shear rate range representative of conditions encountered in centralized systems. For example, changes in apparent viscosity ranging from 10 to 30 per cent at constant shear rate occurred between L/r values of 80 to 1 and 510 to 1 over a shear rate range from 100 to 100 sec^{-1}. For a majority of the samples studied the percentage difference decreased above L/r value of 510 to 1; however the effect persisted for grease "E" up to an L/r value of 2000 to 1.

The purpose of this note is to show that apparent viscosity changes of this type can be attributed in part to a failure to correct for "end-effects" characteristic of efflux-type viscometry. A method for utilizing these end-effect corrections to predict the performance of a grease in a centralized lubrication system from capillary viscometry data will also be described.

THE CAPILLARY END EFFECT

A standard procedure followed in correlating capillary data is to express the observed kinematical and dynamical quantities Q and ΔP in the form of "consistency variables" (2). These are the maximum apparent shear rate R, and the maximum shear stress τ, viz:

$$R = \frac{4Q}{\pi r^3} \qquad [1]$$

$$\tau = \frac{r\,\Delta P}{2L} \qquad [2]$$

the purpose being to remove the dependence on the dimensions of the capillary. Hence a plot of R versus τ for a given material should, in the absence of anomalous wall effects, etc., be a unique composite curve for the material.

It is sometimes found, however, that data for a given radius but different L/r values "spread" rather than coincide, and is thought that the effect arises because no allowance is made for the viscous resistance encountered in flowing in a converging stream from the wider sample reservoir to the capillary inlet. This is the so-called "Couette" effect (3), usually expressed in terms of a hypothetical addition λ to the length of the capillary, viz:

$$L_e = L + nr \qquad [3]$$

where

$$n = \frac{\lambda}{r}$$

The introduction of an "effective" length L_e modifies Equation [2] to an "effective" maximum shearing stress τ_e, viz:

$$\tau_e = \frac{\Delta P}{2\left(\frac{L}{r} + n\right)} \qquad [4]$$

Hence if the spread in a R versus τ plot with a given value of R but different L/r values, is consistent with Equation [4], a plot of ΔP versus L/r will, for a constant value of R, produce a straight line intersecting the negative L/r axis, i.e. $\Delta P = 0$, at the value of n, the end correction.

TREATMENT OF RESULTS OBTAINED

By Miller, et al. (1) on GREASE "E"

The experimental data on Grease "E" at 75 F are shown plotted in the form of R versus τ in Fig. 1; the spread in the flow curves is exactly analogous to the spread in the apparent viscosity versus R plot

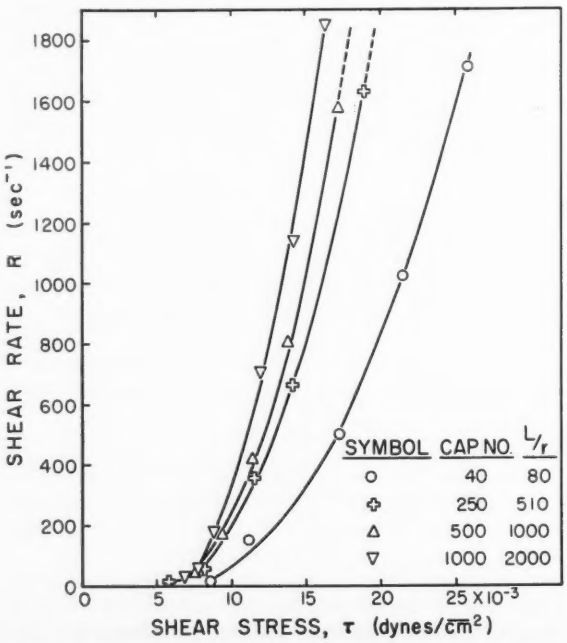

Fig. 1. Capillary Flow Curves for Grease "E" at 75 F (After W. R. Miller and Assoc. *Lub. Engr. 14, 5,* p. 216, 1958)

*** Ed. Note: This paper discusses the results presented by Miller, Walsh and Slaymaker in their paper "Effect of Capillary Length to Diameter Ratio on Grease Viscosity" which was published in LUBRICATION ENGINEERING, June, 1958. In order to avoid confusion with the symbol for shear rate, the present author has used the letter L for capillary radius instead of the letter R used by Miller, Walsh and Slaymaker.**

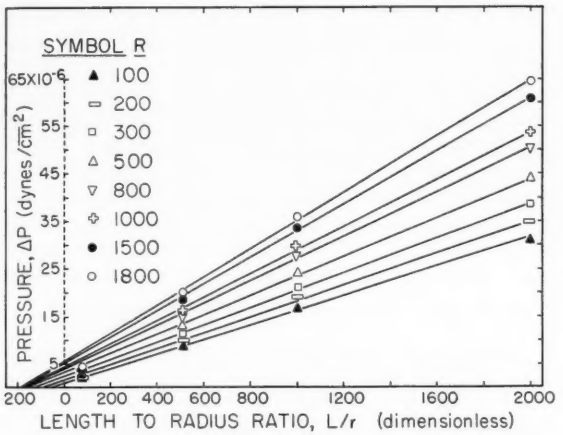

Fig. 2. Pressure versus Length-to-Diameter Ratio as a Function of Apparent Maximum Shear Rate

shown in their Fig. 6. Miller, et al. obtained these data using a capillary 0.097 cm in radius; the L/r values used were 80, 510, 1000, and 2000, corresponding respectively to capillaries No. 40, 250, 500, and 1000. Fig. 2 was prepared by selecting R values of 100, 200, 300, 500, 800, 1000, 1500, and 1800, and calculating for each L/r value the corresponding value of ΔP in dynes per cm² from Fig. 1. With the exception of Cap. No. 40, an approximately linear correlation exists between L/r and ΔP, the curves intersecting the negative L/R axis as predicted. The end corrections derived from the intercepts are plotted versus R in Fig. 3. Although there is considerable scatter, the strong dependence of n on the apparent maximum shear rate is clearly evident. There does not appear to be any evidence of a leveling out in the slope dn/dR until the region of high shear is approached; at R = 1800, n has reached a values of 180. By way of contrast, n is near 0.57 for a simple Newtonian liquid, while for a polyethylene of melt index 7 at 190 C it is near 10 at R = 1800 (4).

Using the n values from Fig. 3, the data of Fig. 1 were corrected using Equation [4]; these results are presented in Fig. 4, a plot of R versus τ_e. With the exception of Cap. No. 40 which was omitted, the data now reduce to a reasonably composite plot for L/r values of 510, 1000, and 2000.

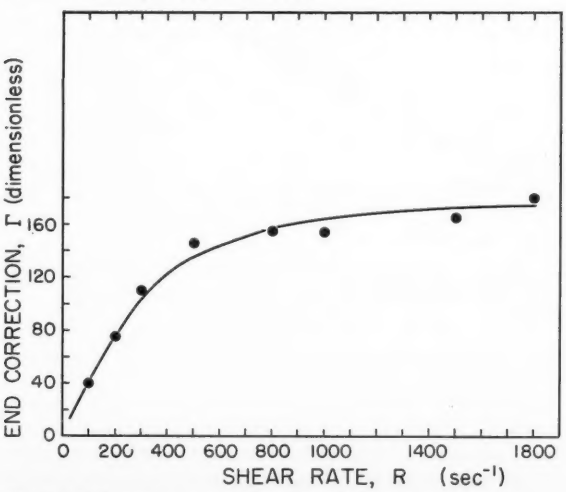

Fig. 3. End Correction versus Apparent Maximum Shear Rate

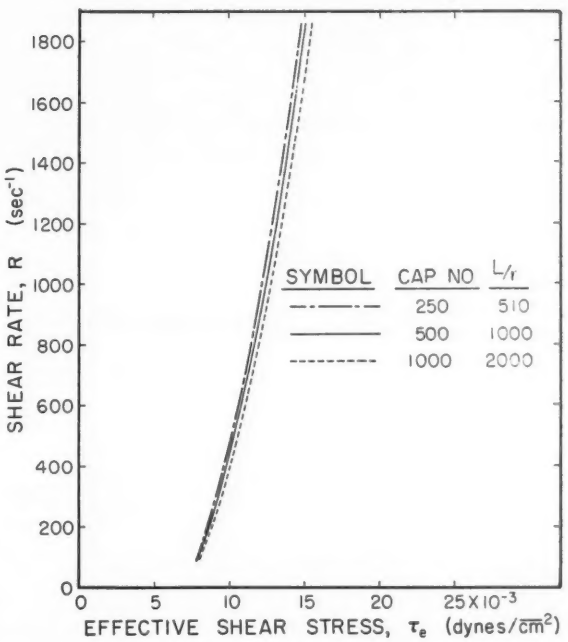

Fig. 4. Composite Flow Curve for Grease "E" after Correcting for End Effect

APPLICATION TO SCALE-UP OF CAPILLARY VISCOMETRY DATA TO CENTRALIZED SYSTEMS

Although the method has only been applied to one sample, the results appear sufficiently interesting to warrant a detailed analysis of the method's utility in predicting grease performance in centralized grease dispensing equipment. For such scale-up studies, the reverse order would be followed. That is, the R versus τ curve of a grease in a distribution system designed for a certain value of L/r would be constructed from the composite curve, Fig. 4, and a knowledge of the functional dependence of n on R. A suggested procedure is to select a particular value of R which is within the operating range of the distribution system and note the corresponding values of n and τ_e from Fig. 3 and 4, respectively. Then calculate τ from the expression:

$$\tau = \tau_e\left(1 + \frac{\lambda}{L}\right) \qquad [5]$$

Repeat the procedure until a series of τ values corresponding to the range of anticipated R values are obtained, and plot R versus τ for constant L/r.

It is possible that this method of analysis may also demonstrate the need for a modification of standard grease capillary viscometers employed in scaling-up studies to designs utilizing L/r ratios greater than 200 to 1.

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3. Barr, G., *A Monograph of Viscometry,* Oxford University Press, p. 20 (1931)
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Some Considerations in the Selection and Use of Water Soluble Cutting and Grinding Fluids

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Machining and grinding operations necessary to produce desired shapes and surfaces of metal parts usually require that fluids be used for such operations. These fluids help to reduce friction and heat, and in many cases, water soluble materials are effective.

Water soluble products offered to industry vary considerably in physical and chemical makeup—and this review is intended to show that the non-cutting or grinding functions of such products must also be considered in an evaluation for production use.

Presented before the 14th ASLE Annual Meeting, Buffalo, New York, April, 1959.

In endeavoring to review the field to determine pertinent considerations in selecting cutting and grinding fluids, it is natural to begin with "soluble oils." These are the most prevalent type of water miscible cutting and grinding fluids and have been used for years in metal cutting and grinding operations. These products consist mainly of petroleum oil base and an emulsifying agent which permits them to be suspended in water to form a milk-white emulsion. Often times special blending agents (to help resist the de-emulsifying effects of high mineral content waters), germicides, fats or extreme pressure agents are added to obtain desired effects.

"Chemical" or "synthetic" cutting and grinding fluids then can be defined as those materials which contain little or no petroleum products but which do contain materials of either organic or inorganic nature, or both. Further, the chemical types form *solutions* in water, rather than *emulsions*.

Water is a better heat conductor than oil and it has a higher specific heat than oil. Now if oil is made emulsifiable as in the case of a "soluble oil," the more oil added to the water, the more reduced is the heat conductance of the mixture. On the other hand, by adding more oil, the rust inhibiting and lubricating properties are increased.

As higher metal removal rates have become more desirable, the heat problem has become more acute, necessitating fluids capable of removing heat more rapidly than is possible with soluble oils or straight oils. Some of the factors responsible for this situation are as follows:

MACHINING

Trigger (1) showed that as speed is increased in turning operations, a logarithmic increase in heat is obtained. For any given feed and depth of cut, harder metals produce more heat than softer metals cut at the same speed (Fig. 1).

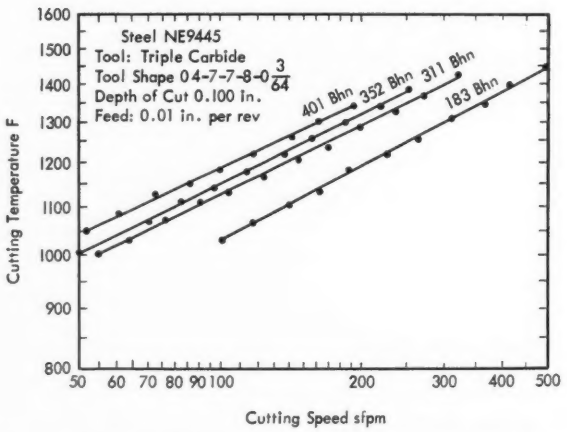


Fig. 1. Cutting Speed-Cutting Temperature Relationships Using Triple-Carbide Tool.

Secondly, soft metals produce thicker chips than harder metals at the same feed rates, and as speed is increased, chips become thinner (1), (Fig. 2).

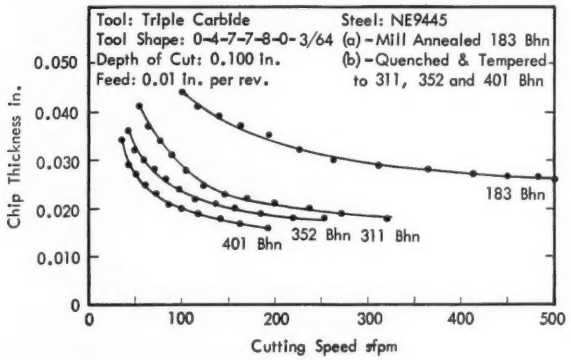


Fig. 2. Effect of Cutting Speed on Chip Thickness.

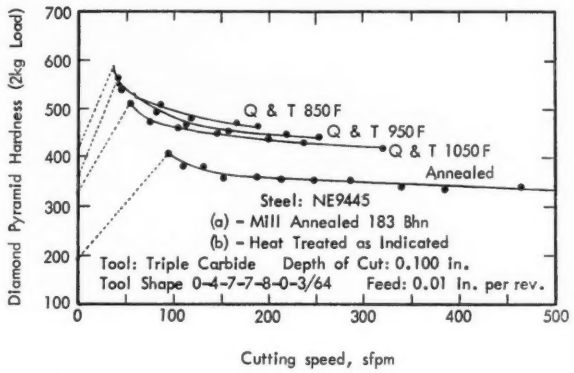


Fig. 3. Effect of Cutting Speed on Chip Hardness.

Third, chips are harder than the metal being cut and become softer as speed is increased (1), (Fig. 3).

Fourth, chips become smoother as speed is increased, presumably because there is less time for the chips to pressure weld onto the tool (1), (Fig. 4).

In a practical way, these results are shown by Hebert and Fersing (2) on a production pinion turning operation—showing finishes obtained in turning with high speed steel tools at a minimum speed of 300 sfm compared with turning with cemented carbide tools at 1000 sfm (Figs. 5, 6).

Fersing (3) also showed that as speed is increased to approximately 400 sfm both the feed force and tangential force on the tool were reduced (Fig. 7).

Heat is the enemy of tools because it softens them, reducing their useful cutting life. (4) (Fig. 8).

These foregoing facts are condensed in the following diagram (Fig. 9): The ideal situation would be one where chips are hot (therefore more plastic) and the tool cold, but the nearest approach to this is the case of a carbide milling cutter where it is cutting in a fraction of its travel, cooling in the air the remainder of the time. In other operations, where cutting is continuous, more heat builds up in the tool, reducing its life.

Thus, compromises have to be made so that if it were possible to cool more rapidly by means of a fluid more effective than soluble oils or straight oil, then one could machine at higher rates of speed and get long tool life, smoother finishes, closer tolerances and greater rates of production per man-hour.

Water would be a logical answer. However, although water is an excellent conductor of heat, it does not "wet" or "spread" as well as oil and wants to "ball up." This is because water has a high surface tension, because the water molecules are more attracted to each other than they are to most other surfaces. Pure water has an extremely high surface tension—(72 dyne per cm²)—unique among most liquids.

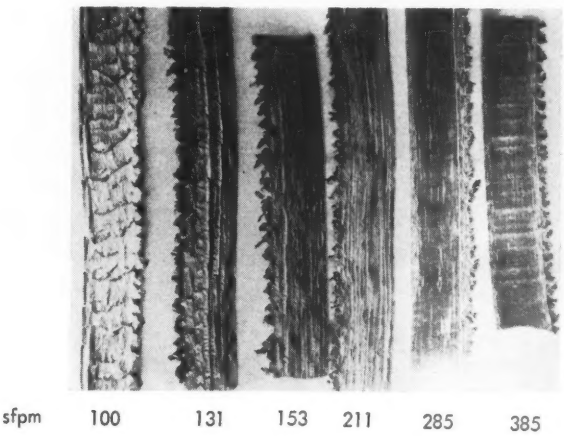


Fig. 4. Typical Chips using Tungsten Carbide Tool; x 4½
Steel: NE9445 annealed 183 Bhn
Depth of cut: 0.100 in.
Feed: 0.01 in. per revolution

If however, a soap or other wetting agent is added to water, the surface tension is immediately reduced, causing the water to wet and spread over other surfaces. This is shown in (Fig. 10).

On the other hand, oil made emulsifiable in water has a surface tension intermediate between pure water and water with wetting agents, as shown in Table 1.

At best, soluble oils have a surface tension of approximately 35 dynes/cm² and as good wetting is not obtained until a minimum of 30 dynes/cm² is reached, it follows that soluble oils or other emulsifiable products in water cannot wet and spread like water with wetting agents.

One effect of using wetting agents is an improvement in heat conducting properties of water compared with using emulsifiable oil in water. In this test (5), a cube of 403 stainless steel having a thermocouple in it, and attached to a potentiometer, was heated to 1500 F and the stainless steel cube was plunged into equal volumes of fluids shown. The accompanying chart (Fig. 11) shows the rate of heat conductance.

It will be noted that there is little difference in heat removal ability between 2½% and 10% of the chemical type fluid, whereas there is a great difference between 5% and 10% soluble oil. This is a significant fact for as one increases the concentration of

soluble oil, the heat conducting capacity is reduced, whereas this is not appreciable in the case of the chemical or synthetic type fluid—one can increase concentration in order to improve "lubricity" and meet job requirements, without seriously affecting heat transfer.

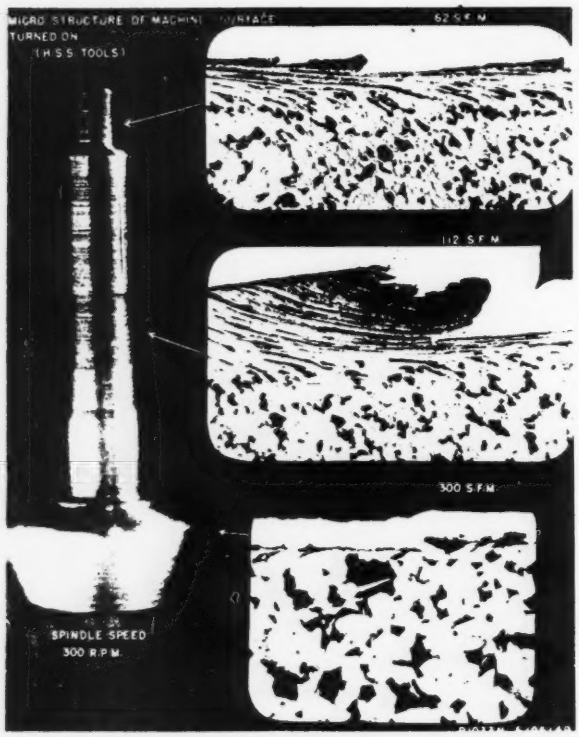


Fig. 5. Pinion Gear machined with HSS tools.

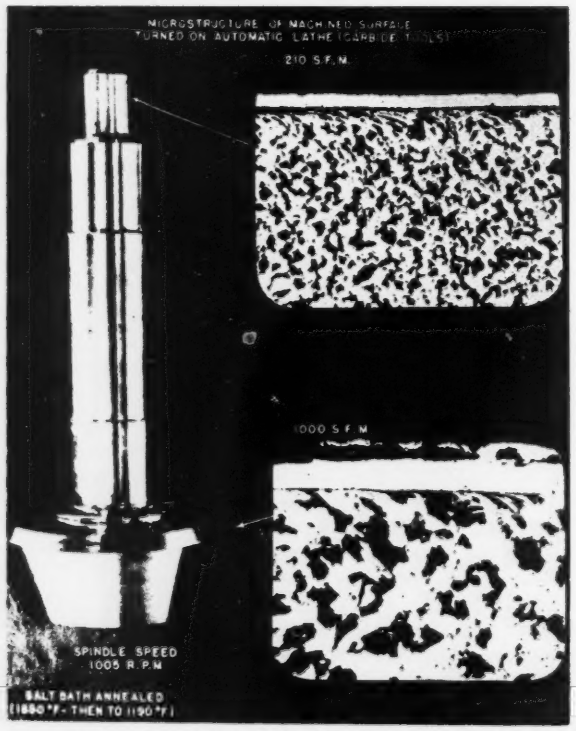


Fig. 6. Pinion Gear machined with Carbide tools.

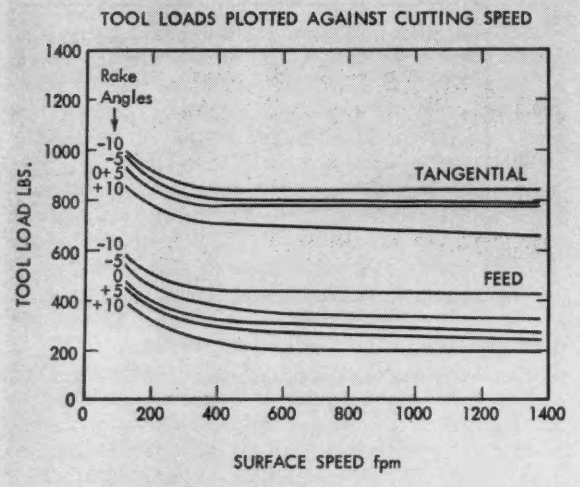


Fig. 7. Tool loads plotted against cutting speed.

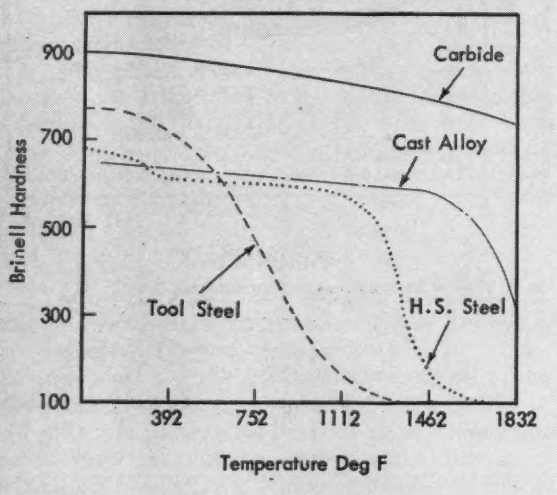


Fig. 8. Effect of temperature upon the hardness of tool materials based on data by E. Amman. Hardness of cast material was estimated by performance in hot milling.

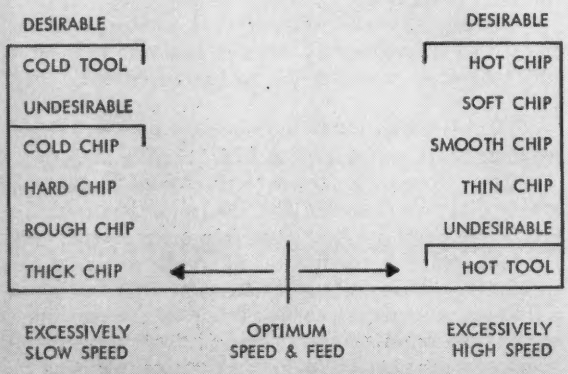
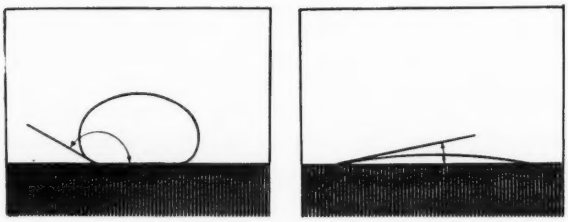


Fig. 9. Desirable and undesirable conditions in cutting.



"Poor wetting" or spreading is shown by large contact angle of drop of solution on surface.

"Better wetting" or spreading is shown by low contact angle of drop of solution on surface.

Fig. 10. Relation between wetting and contact angle.

TABLE 1. RELATIVE SURFACE TENSION OF SOLUBLE OIL VS CHEMICAL COOLANT
SURFACE TENSION (DUNUOY)
WATER = 72 DYNES

SOLUBLE OIL CONCENTRATE			CHEMICAL CONCENTRATE		
PARTS WATER	PARTS CONCENTRATE		PARTS WATER	PARTS CONCENTRATE	
8	1	35.7 DYNES	8	1	26.4 DYNES
12	1	37.3 DYNES	12	1	26.7 DYNES
16	1	38.2 DYNES	16	1	27.0 DYNES

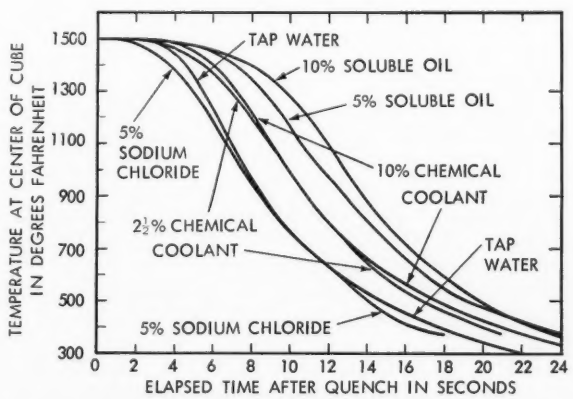


Fig. 11. Effect of various fluids on cooling rate.

If one examines a soluble oil emulsion under the microscope, one can see globules of oil and can measure their size—usually of the order of 2 to 5 microns, (0.00008 − .0002 inch). The chemical fluids on the other hand (those at least which contain wetting agents) usually have a maximum particle size of 30 Ängstroms $\frac{3}{25{,}000{,}000}$ inch—approximately $\frac{1}{700}$ to $\frac{1}{1{,}750}$ as large as the oil droplets in soluble oil, as shown in Fig. 12.

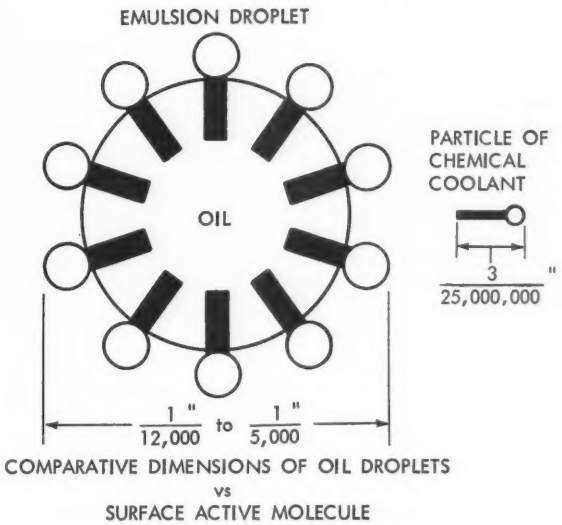


Fig. 12. Comparative Dimensions of 0.1 Droplets vs. Surface Active Molecule.

Merchant (6) has presented an idealized picture of the voids existing between tool and chip in cutting operations (Fig 13). Hence, if the fluid can get between chip and tool, it seems reasonable to assume that a fluid of smaller particle size and lower surface tension could get into the voids more readily than a fluid of larger particle size and higher surface tension. This seems to be borne out by the fact that in actual production, the chemical type cutting fluids do result in lower temperatures at the higher cutting speeds, wherein the tool, chips and workpiece have a lower temperature than when machined with straight oils or soluble oils. This same effect exists in grinding operations, also.

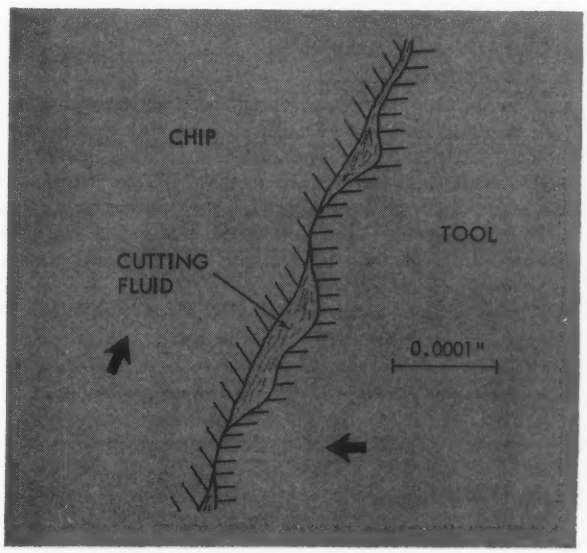


Fig. 13. Imaginary, Highly magnified Cross Section of Small Portion of Chip Tool Interface.

TYPES OF CHEMICAL FLUIDS

The strictly chemical products show a great variety of composition and will essentially consist of rust inhibitors, mild lubricants, germicides, wetting agents and water conditioners. They will vary considerably in rust prevention properties, lubricity, wetting characteristics and resistance to hard water, depending upon their chemical composition. They will often vary considerably with respect to the residue left after the water evaporates. This latter effect is more noticeable in the winter time when lower humidity and low temperatures tend to produce harder deposits than in the summer time when humidity and temperature are higher.

A great number of such products now available fall into two general classes:

1. those with wetting agents and good lubricity
2. those without wetting agents or good lubricity.

The ones with lubricity and wetting agents have low surface tension. When properly formulated, they resist the growth of bacteria which cause "stink" and are quite resistant to hard water. They have good rust inhibiting properties and leave a residue which is liquid. On normal operations, their slight foam is not a factor, but they may foam excessively when air is beaten into them as for example, in disc type surface grinders. Their excellent lubricating qualities keep machine slides, turrets and other moving parts working smoothly—a very important factor as automation increases in use. This lubrication ability and high heat conducting capacity make them suitable for many "tough" operations such as reaming, tapping, threading, broaching and sawing in addition to the usual operations of turning, drilling, milling and boring. Lately, they are being applied also to gear cutting as well as shaving, where their high lubricity and excellent cooling allow faster cutting rates and yield better finishes and closer tolerances than was possible with many straight oils. The fact that parts do not have to be degreased between production and inspection also saves times and money.

These same products when used for machining cast, nodular and malleable iron, produce excellent finishes, parts can be produced faster, closer tolerances can be held and chips do not "clinker" to the machine tool nor on finished parts.

The group of chemical fluids without wetting agents usually do not have much lubricity and unfortunately, many of them leave crystalline or waxlike deposits upon evaporation of the water and this eventually interferes with machine action. Many of them do not have enough lubricity to do the "tough" jobs and do not produce as good finishes in machining or grinding as the products with good lubricity factors. The chemical fluids without wetting usually do not "scum" in hard water. They resist the growth of undesirable bacteria and have excellent cooling and rust preventive properties. They can be added to soluble oil, or the wetting agent—chemical type cutting and grinding fluids, in cases where modification of properties is desired. Usually, the chemical type fluids without wetting agents do not foam appreciably, hence are used on jobs where foaming may be a factor.

The chemical type products usually produce a clear solution with water so that the operator can see the work much easier—whereas soluble oils are opaque and it is impossible to see through them. This adds to operator efficiency and acceptance of the chemical type products.

GRINDING

It is known that grinding efficiency is promoted by fluids having high lubricity (7), (8). This is shown by grinding ratio, surface finish, depth of cut and horsepower evaluations (9), (Figs. 14, 15, 16).

It is also known that increasing the concentration of soluble oil will improve finish, reduce wheel wear and require less horsepower (10), (Table 2). This same situation exists with the chemical type fluids, especially those which contain wetting agents and other type lubricants. Increasing the lubricity of the fluid makes the wheel less "sensitive" to variables in the workpiece and other factors whereas fluids low in lubricity are not as effective in producing a good finish nor in reducing wheel wear, and will require more horsepower. Fortunately, richer solutions also improve rust inhibition and keep machines in better working condition (11).

Previously, when the relative cost of wheels was high and labor low—it was the practice to use wheels as "hard" as possible to make them last. Today, when wheels are relatively cheaper and labor relatively expensive, it is more economical to produce parts *faster* by using as coarse a wheel as possible, and use a fluid of high lubricity. By "matching" the wheel to a high lubricity fluid, excellent finish is obtained, horse power is reduced and long wheel life is attained with continued excellent size control of workpiece but at a much reduced production cost.

Evidence is also accumulating that chemical type fluids have special benefits in grinding certain metals (12), (13), (14), (15) and it is hoped that additional information may be obtained as time progresses.

Soluble oils have the property of carrying metal chips and graphite in the oil droplets when grinding cast iron—making the emulsion "muddy." The chemical fluids which contain wetting agents also carry the graphite particles in suspension because it "wets" them, but they allow metal chips to drop out of suspension rapidly. This is not the case with the chemical fluids which do not contain wetting agents. Here, because they do not "wet" the graphite, the graphite will float on the solution and can be scraped off the top. The metal chips sink rapidly, so that clean solution will be pumped onto the wheel and workpiece.

Hence, chemical fluids without wetting agents are best for grinding cast, nodular and malleable iron as well as carbon parts, where cleanliness or good rust inhibition and cooling without the need for lubricity is important. But when grinding steel or other materials where lubricity is necessary to impart good finish and long wheel life, the chemical types with wetting agents are more effective.

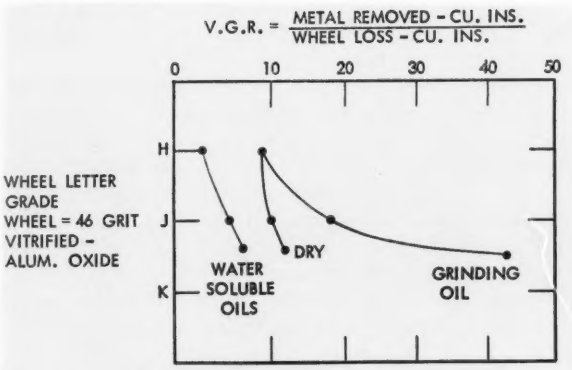


Fig. 14. Effect of fluid on grinding ratio.

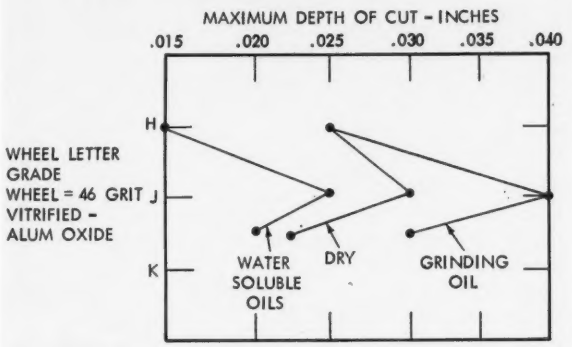


Fig. 15. Effect of fluid on maximum depth of cut.

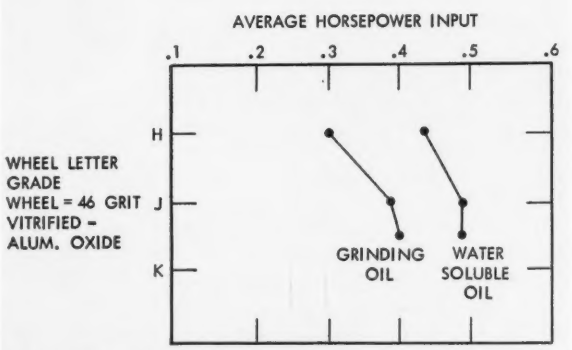


Fig. 16. Effect of fluid on horsepower input.

CORROSION

One great advantage which "straight" oils have over water type fluids is superior rust inhibition. The combination of oxygen and water promotes rusting of machine tools and machined or ground parts, unless otherwise inhibited. Because "straight" oils do not have water, rusting cannot occur. Any fluids which are water soluble must contain adequate rust inhibitors and the ratio of the concentrate to the water used must be carefully controlled for adequate protection.

The oils used in water emulsifiable products are excellent rust inhibitors. When used in normal concentration they protect quite well against corrosion and when the water evaporates, an oily residue remains which is usually "self-healing"—it spreads back again if displaced, and thus protects. Thus, soluble oils act primarily as a mechanical barrier to prevent oxygen and water of the atmosphere from reacting with the metal to form iron oxides known as rust.

Chemical or synthetic fluids on the other hand, act primarily through a chemical effect. Phosphates, borates, chromates, nitrites (16) or mixtures of them, with or without special soaps and amines prevent the oxygen and moisture of the air from reacting to form rust. An especially effective combination is the use of chemical inhibitors along with soluble oils so that a combined effect of chemical and physical barrier type of film is obtained.

It has been noticed that the rust inhibiting effect of soluble oils is rapidly lost when machining cast iron. Apparently the chips produced, exhaust the oil from the water in a soluble oil mixture, leaving it more dilute. This then results in the chips eventually "packing" over the machine tool, allowing rust to occur. Hence, when machining cast iron, it is advisable to add some soluble oil concentrate regularly in order to maintain proper concentration. Usually, soluble oil must be used two to three times more concentrated to prevent corrosion when machining cast iron than when machining steel.

The chemical type cutting and grinding (because of being solutions and not mechanical emulsions) are not as readily depleted from the water as is soluble oil when machining cast iron. The chemical type fluids can usually be used much more dilute to begin with and replenishment is required less frequently also.

TABLE 2. Effect of Varying Concentration of Soluble Oil on Grinding Effect
Cylindrical Grinder—Wheel Speed = 6,3000 S.F.M.—Work Speed = 70 S.F.M.
Materials = 302 Stainless Steel = Rc–55

MATERIAL	SOLUBLE OIL CONCENTRATION	GRINDING RATIO	FINISH M.I. R.M.S.	POWER H.P.	GRIT TYPE	BOND	GRIT SIZE
STAINLESS	1–40	1.4	135	5.4	SILICON CARBIDE	VITRIFIED	46
STAINLESS	*1–10*	*3.3*	*120*	*4.8*	SILICON CARBIDE	VITRIFIED	46
AISI Type 02	1–40	22.1	70	4.8	ALUMINUM OXIDE	VITRIFIED	46
AISI Type 02	*1–10*	*30.8*	*40*	*4.3*	ALUMINUM OXIDE	VITRIFIED	46

Too, the chemical type fluids hold up much better against attack by bacteria than do soluble oils when working cast iron. There is also much less tendency for the chips to "pack" on the machine tool when using chemical type fluids.

Naturally, if straight oil type products are used on cast iron for special operation such as broaching, tapping or reaming (where heat is not too important a consideration) the chips produced will not "pack" on the machine tools, nor will they rust.

WATER

The type of water available for mixing with water base cutting and grinding fluids will have a great effect upon the stability and performance of such fluids.

Pure water when evaporated will leave no residue. This type of water seldom exists in industry. Most waters contain dissolved solids or minerals and these are left behind when the water evaporates (17). Usually when they are present, the type and amount varies considerably from day to day or from season to season, depending on water source, thus their effect on the fluid will cause considerable fluctuation on fluid properties and results. The minerals are composed of two chemical portions—one known as the cation, which has a positive electric charge and may be monovalent or polyvalent. Typical of the monovalent are sodium and potassium ions. Typical of the polyvalent are ferric and ferrous, aluminum, calcium and magnesium ions.

The other chemical portion is known as the anion, which carries a negative charge. Typical of the monovalent anions are the chloride, nitrate and bicarbonate ions, whereas typical polyvalent anions are the sulfate, carbonate and phosphate ions. "Hardness" of water relates to the concentration of polyvalent anions such as calcium and magnesium. These elements are objectionable because they can react chemically with some types of anionic emulsifiers in emulsifiable oils and with certain types of anionic soaps and wetting agents. The result of these reactions is formation of compounds which have reduced solubility in water—so that emulsions are "broken" or that wetting agents or soaps will form "sticky" residues which will retard smooth machine action. Another result of this chemical reaction is that the effective concentration of the emulsified oil or the wetting agents is reduced (by being less water soluble) so that rust inhibition will be reduced.

On the other hand, the cations of the type of chlorides and sulfates will not react chemically with the emulsifiers used in making soluble oils, nor with wetting agents. However, very high concentrations will have a "salting out" effect, and in this manner tend to reduce their concentration in the water. However, an even worse effect is that these molecules (chloride and sulfate) are capable of promoting severe corrosion and the more concentrated they are, the worse is their effect (16). Further, the sulfate ion is excellent food for the growth of sulfate reducing bacteria which are the main cause of spoilage and "stinking" of water base metal working fluids.

Soluble oils and the chemical type concentrates vary greatly in their resistance to mineral constituents in water. Naturally, those which are most stable result in giving the best performance so that each product to be considered for use should be evaluated for resistance to "hardness" and other minerals if the water used has a relatively high concentration of such dissolved solids.

When water which contains dissolved minerals evaporates, the minerals are left behind. These minerals when dry are usually very hard and abrasive and can seriously affect the working parts of machine tools. Because water evaporates from the fluid, and because water and fluid concentrate are lost by dragout on work piece and chips—some fluid replacement will be required daily (as much as five gallons per day in a 25-gallon capacity turret lathe, for example) usually more in summertime than in the winter. Thus as time goes on, the solids content will continue to increase and theoretically could be three to five times as concentrated at the end of a month than the original content.

"Hardness" of water is designated as "grains" and in the U. S. system, one grain hardness is equivalent to 17 ppm of calcium carbonate. Hardness is relative and varies from "soft" to "extra hard."

Waters over 300 ppm (18 grains) begin causing serious trouble with cutting and grinding concentrates, resulting in corrosion and stickiness or gumminess. Some manufacturers suggest the addition of water softening compounds such as phosphates or borates and although they are helpful, are *NOT* the best solution to the problem. For one thing, adding such materials, although they reduce the "curding" of the coolant solution, they themselves *ADD* to the total content of dissolved solids, further complicating the situation.

In other words, in those cases where natural mineral content of the water is relatively low, some softening agents may be suitable—but in those cases where mineral content is high, the best technique is to remove these minerals entirely, which would result in practically pure water. One of the first satisfactory processes for softening water was the zeolite process in which the polyvalent calcium and magnesium ions were replaced with the sodium ion. While this removed the "hardness," it left the dissolved sodium ion together with the original chloride or sulfate ions. In other words, while the "hardness" was removed, still the dissolved salts remained with their attendant capacity to induce rust.

The best technique is that of the de-ionizing system, in which the polyvalent cations (usually calcium and magnesium) as well as the anions (mostly chloride and sulfate) are removed, resulting in a practically pure water. The economies to be realized by this technique are tremendous. Not only is it possible to use considerably less cutting and grinding concentrate and yet maintain lubricity and prevent rust, but machinery will be kept working more smoothly because of lack of build-up of dissolved minerals. Machine maintenance can be a very expensive item in bad water areas and the installation of a satisfactory de-ionizing unit can usually be made for five percent to ten percent of the cost of a turret lathe and yet the installation of such a de-ionizing unit can pay for itself in reduced maintenance for a complete shop in three to six months! In this system, bad water can be treated so as to be pure water for as little as ½¢ to 1¢ per gal-

lon, or 2½¢ to 5¢ per day for makeup for a typical turret lathe, for example.

In short, water can be "hard" or "soft," it can be high or low in dissolved solids. Hardness in water can cause separation and gumminess of cutting and grinding fluid concentrates. A soft water can be corrosive or non-corrosive and a hard water can be corrosive or non-corrosive—in all cases—depending upon the *type* of dissolved solids. It is best for the action of the coolant concentrate if the water used with it is as free as possible of dissolved minerals, and the best present method to use is the de-ionizing process. A satisfactory alternative is steam boiler condensate—available in some shops.

RESIDUE

The type of residue left after the water evaporates from a water soluble cutting and grinding fluid is extremely important. The machine tool using such fluids is usually quite expensive so that any "gumminess" or "stickiness" resulting from that concentrate can seriously impair the working of many such machines and cause excessive maintenance costs.

For best results, cutting fluid residues should remain fluid and should redissove readily when put into water or when additional solution splashes onto it. Some products leave deposits which are crystalline, others paste-like and still others, wax-like in nature, but the safest and most sasifactory residue from the standpoint of machine maintenance are fluid films. Some products may leave a fluid film initially but may oxidize and become sticky, hard, or water insoluble upon aging. One should guard against using material of this type, also. It is desirable that the residue have excellent lubricating properties so that even if normal lubricating oils are displaced by the cutting fluid, there will remain sufficient lubrication for proper machine action.

BACTERIA

It is becoming more necessary as time goes on, to prevent the growth of bacteria which are responsible for the formation of undesirable odors and often, corrosion, in water-base cutting and grinding fluids. Bacteria of the sulfate reducing type are the most common bacteria responsible for the formation of hydrogen sulfide in such fluids and are usually accompanied by the presence and growth in the same mixture of bacteria known as pesudomonads (18) (19).

Bacteria must have water in order to grow, hence straight oils seldom foster bacterial growth. Bacteria de-stabilize water type cutting and grinding fluids because they feed on them and change their chemical nature. Not only do bacteria dispel undesirable hydrogen sulfide gas which has a disagreeable odor but this gas as well as other by-products of bacterial growth are corrosive to machines and finished parts. In addition, bacteria in large numbers can congregate, forming a slimy mass which when given sufficient time, can actually clog lines in machines, can cause 'sticking" of machine moving parts and can form sludge in coolant tanks, impeding pump action and also be difficult to clean out. It is suggested that machine tool builders can provide a real service to industry by so designing coolant system to be more accessible to the air and be made more accessible for cleaning.

In the past, many attempts have been made to add germicides to soluble oil concentrates in order to prevent bacterial growth. The great difficulty has been to find a germicide sufficiently oil *and* water soluble to be effective after the oil has been added to the water.

One way to get around the problem is to formulate products in which bacteria have little chance for survival—or to formulate truly water soluble materials with which water soluble germicides will be effective. The problem becomes much simpler when the latter approaches are taken, rather than to formulate around water dispersable products which at best are only mechanical dispersions, subject to de-emulsifying effects by extreme changes in temperature and by effects of hard waters. A true chemical solution appears easiest to formulate with germicides and their increasing popularity because of resistance to bacterial growth makes them an increasing factor in the metal working industry.

BACTERIA AND DERMATITIS

It is a common fallacy that bacteria present in water base metal working fluids often cause dermatitis. This is definitely not the case as it has been repeatedly demonstrated that seldom do pathogenic bacteria survive in such mixtures. Most dermatitis, if it does exist, is usually the result of poor housekeeping and bad personal hygiene habits on the part of the operator. Frequently, the indiscriminate use of solvents for washing of parts (particularly of parts with hydrolizable chlorinated oils on them) will also cause dermatitis. There is no doubt about the fact that good housekeeping, including periodic cleaning of coolant sumps, in addition to operator personal cleanliness will go far in keeping dermatitis to a bare minimum. (20)

CONTROL

As stated previously, straight oils do not present much of a maintenance problem. They do not change appreciably during use compared with water soluble cutting and grinding fluids.

Water soluble materials however, are definitely affected by various kinds of minerals present in water and also, since water has the property of evaporating, it will considerably affect the ratio of water to the concentrate even in the course of one day. It is not unusual to find a ten-fold variation in ratios in the course of a month! Because cooling, rust inhibiting and lubricating effects are definitely influenced by ratio of water to the cutting or grinding fluid base, it is necessary to control concentration of each in order to get uniform results. This becomes more critical as metal removing rates go to higher and higher values! It is suggested that all water type cutting and grinding fluids be mixed in a tank and dispensed as needed for each machine. Operators should definitely *not mix their own materials* as they will not control them adequately.

Periodic checks should be made on the cutting and grinding fluid concentrations. With soluble oils it is usually done by "splitting" with acids or salts, whereas with chemical types a check is made by acid titration or titration for nitrites or other chemical components.

These procedures are relatively simple and are quite reliable.

In the case of central systems where the leakage of lubricating and hydraulic oils are an important factor in modifying cutting and grinding fluids, the continuous use of centrifuge to remove such oils is advocated. The use of a centrifuge definitely keeps such fluids much more stable and considerably lengthens their useful life.

Another pertinent part of control is that of keeping out of the cutting and grinding fluids anything which will contaminate them. This is important, not only from the standpoint of keeping the mixture uniform but also from the standpoint of bacterial control. It is also desirable to clean the machines with a germicidal cleaner on a regular schedule.

There will undoubtedly always be need for cutting and grinding oils of the water insoluble type, depending upon particular machine tool requirements and the peculiarities of the operation itself.

There will also probably be many uses for soluble oils, which because of low price and because of the type of operation, will be satisfactory. However, as the need for higher speed and tougher alloys continues, there will be an increasing need for chemical type cutting and grinding fluids.

As the metal working industry understands more fully the characteristics of each type of coolant and its mode of action, each will find its most effective use in industry and will contribute its share in improving procedures and efficiency.

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RAPID DETERMINATION OF HEAT CAPACITY OF LIQUIDS OVER EXTENDED TEMPERATURE RANGES

(Con't. from page 107)

TABLE 3. CALCULATED HEAT CAPACITY ERRORS

TEMPERATURE °F	STANDARD ERROR
68	±0.017
176	±0.012
284	±0.009
392	±0.012
500	±0.017

CONCLUSION

It is concluded that this calorimeter design provides a simple and rapid determination of liquid heat capacities. The method of calculation utilizes the small heat losses which cannot be prevented in simple calorimeters. This method is applicable over wide temperature ranges and will provide results sufficiently accurate (within 5 per cent) for engineering design.

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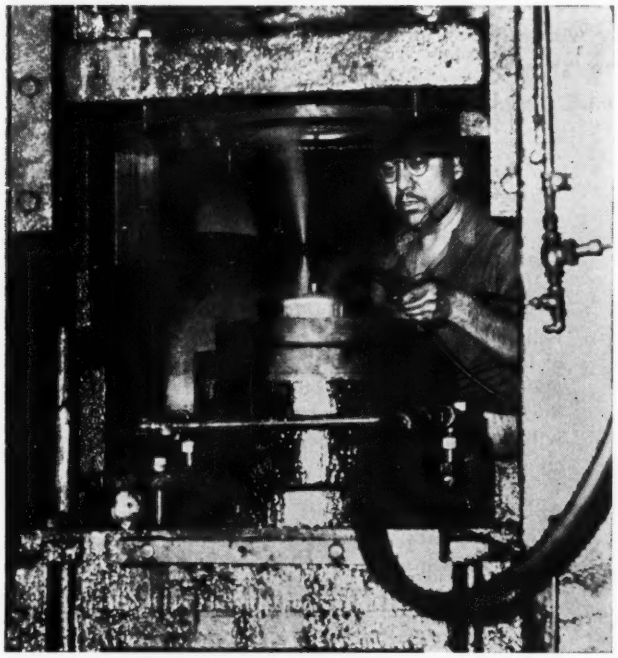
FORGING OR TAPPING . . . 'dag' DISPERSIONS BRING IMPRESSIVE SAVINGS

The versatility of Acheson 'dag' brand dispersions has been proven in many metalworking applications. Here are two such examples: the one involving the material-time savings possible by the use of sprayable colloidal graphite; the other, overcoming pressure and frictional heat problems with the use of a mica dispersion by Acheson.



'Prodag' is automatically spray-applied simultaneously on both upper and lower die surfaces of this forging press at Mueller Brass.

Mueller Brass Company saves $15,000 a year in labor-material costs alone. This is in addition to increasing die life, reducing the scrap loss, and improving the finish of their forgings . . . the reasons why Mueller initially chose Acheson's Prodag® over other forging lubricants. The total savings can be estimated as "considerable", since this Port Huron, Michigan company is the world's largest producer of brass and bronze forgings.

Before using 'Prodag' — a dispersion of graphite and water, Mueller lubricated their crank forging presses with a highly viscous, petroleum-based material which had to be swabbed by hand between each press stroke. The human element frequently meant too much lubricant being applied in some areas of the die, too little in others. The result in the first case, was either imperfect forgings or cracked dies brought about through displacement pressures. In die areas where there was insufficient lubrication, metal stuck in the die cavity. The forged piece had to be scrapped and time was lost while the metal was pried out of the die.

To overcome these multiple problems, Mueller was introduced to a sprayable lubricant and designed their own spray equipment, which lubricates lower and upper dies simultaneously. In this application, 'Prodag' is diluted 1 to 35 with water and is kept under agitation at the press. Time studies have shown that spraying has given them a five percent-per-pound economy over swabbing. Even more importantly, the use of 'Prodag' has resulted in more uniform, complete coverage. The $15,000 to $17,000 annual labor-material savings has, in Mueller's opinion, actually been a "bonus" over and above their original purpose of achieving better forgings and greater die life.

'dag' 242 improves hole tapping operation at General Steel Wares' Montreal Plant

Hole-tapping operations at General Steel Wares, Ltd., Montreal, Quebec, have improved with the application of 'dag' 242 — a dispersion of mica in petroleum oil. So much so, in fact, that an annual savings of approximately $8400 has been realized. The problem was this: broken spud threads during tapping operations on galvanized range boilers, caused a reject percentage of 27%. Fed to the tap as pictured below, the area of the boiler spud was subjected to high pressure and frictional heat. A proprietary type of water-soluble paste had previously been used.

Mr. E. R. Hails, Works Manager at General Steel Wares, found, after detailed investigation of all components involved in the operation, that the lubricant was the key to greater efficiency and fewer rejects. 'dag' 242 was recommended and put into use. Applied by brush to the tap and spuds, this material was immediately effective. The results speak for themselves; from an average life of 3000 spuds per tap, General Steel Wares now averages over 14,000 per tap with 'dag' 242.

Before threading range boiler holes, 'dag' 242 is applied by brush to the tap and spuds.

Perhaps you could be earning similar production economies by using one of the many fine Acheson Dispersions tailored for metalworking use. For further information write for your copy of Bulletin 426 — For Metalworking Applications. Address Dept. LE-30

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A. B. Wilder
ASLE President
Keynote Speaker

ANNUAL SHORT COURSE IN LUBRICATION ENGINEERING 1960

Sponsored by the ASLE Education Committee
Chairman—M. E. Dougherty,
Acheson Colloids Co.,
Port Huron, Michigan

To be held concurrently with technical sessions
April 19, 20, 21, 1960
Netherland-Hilton Hotel, Cincinnati, Ohio

M. E. Dougherty
Chairman, Education
Committee

Tuesday, April 19, 1960—LUBRICATION FUNDAMENTALS 9:00 a.m.—12:00 noon

Introduction: Dr. A. B. Wilder, President, ASLE
E. I. duPont deNemours Co., Inc.
Chicago, Illinois

The purpose of the course and a short discussion on the history and science of lubrication.

Boundary Lubrication: Dr. M. E. Merchant, Director of Physical Research, Cincinnati Milling Machine Co., Cincinnati, Ohio

When a fluid film of lubricant is unable to exist to keep two moving surfaces from contact, boundary lubrication must be depended upon to keep friction, wearing and scoring at a minimum. With no protective film, the surfaces will actually unite or bond together. To function as a boundary lubricant, a substance must reduce or prevent this metal-to-metal contact, by forming a film which will not flow out under the action of the contact pressure. The mechanisms by which this boundary lubrication are accomplished in practice will be illustrated by the use of the motion picture, "The Basic Principles of Lubrication."

Thick Film Lubrication: Fred Hanly, Research Engineer, California Research Corp., Richmond, California

Some of the principles of lubrication will be covered by lecture as well as film. Subjects treated include: Influence of Friction Under Dry and Lubricated Conditions; Development of the Tapered Oil Film and Its Effect On Friction in Pivoted Pad and Journal Bearings; Oil Film Pressure and Grooving; Sparse Lubrication; and Principles of Hydrostatic Lubrication and Its Applications.

Tuesday, April 19, 1960—LUBRICANTS

2:00 p.m.—5:00 p.m.

Properties of Lubricants: Robert McKay, Product Development Lab., Cities Service Research and Development Co., Cranbury, New Jersey

The properties of lubricants will be discussed and methods of measuring these properties will be described. Factors which influence lubricant performance will be treated including conditions that lead to failure of lubricated parts and analyses of such failures. The operation of lubricated parts will be related to lubrication theory so that practicing lubrication engineers will be able to utilize bearing theory to improve machine performance.

Application of Lubricants & Maintenance of Lubricating Equipment: W. Shinn, Lubrication Engineer U. S. Steel Corp., Fairless Hills, Pennsylvania

A discussion of the various methods and equipment for handling and dispensing bulk lubricants, centralized systems, oil circulating systems and maintenance problems in connection with this type of equipment.

Lubrication Engineers Manual E. Polick, Lubrication Engineer, U. S. Steel Corp., Pittsburgh, Pennsylvania

Short discussion and distribution of U. S. Steel Corp., "Lubrication Engineers Manual"

Solid Lubricants and New Ideas on Dry Films: Arthur Stock, Manager, Research & Development, Acheson Colloids Co., Port Huron, Michigan

The use of solid lubricants in liquid media will be discussed. Properties of graphite, molybdenum disulfide and TFE resins will be pointed out and demonstrated by slides. Theory of thin film solid lubricants will be briefly talked about, and the use of dry film in practice will be illustrated.

Tuesday, April 19, 1960—LATE SESSION

7:30 p.m.—9:00 p.m.

FILM PRESENTATIONS

"Inside Story" Socony Mobil Oil Company

By means of animation and actual photography you will be able to see the fundamentals upon which correct lubrication is based.

"Lubrication Ain't No Problem" Westinghouse Electric Corp. This film clearly illustrates why lubrication of conventional motors is such a costly hit-or-miss proposition. "Oil Films in Action" General Motors, Mechanical Dept. Covers the fundamentals of fluid film friction and how the pressure varies in the oil lubricant journal bearing under high load and no load conditions.

Wednesday, April 20, 1960—BEARINGS, GEARS, SEALS & PACKINGS 8:30 a.m.—12:00 noon

A Lubrication Engineer Looks at Bearings, Bearing Problems and Bearing Lubrication: R. J. Torrens, Eastman Kodak Co., Rochester, New York

Discussion will have emphasis on bearings, their design, lubrication and some of the common causes of trouble.

A Lubrication Engineer Looks at Gears, Gear Problems and Gear Lubrication: Tom Bessent, Lubrication Engineer, Bethlehem Steel Corp., Sparrows Point, Maryland

Principles of gear lubrication and maintenance will be discussed.

A Lubrication Engineer Looks at Seals, Packings, and Their Lubrication: Dr. George Schmidt, Manager Technical & Research Development Dept., Crane Packing Co., Morton Grove, Illinois

A survey of this field covering mechanical seals, gaskets, packings and stuffing boxes, and emphasizing the details of lubrication and maintenance.

Wednesday, April 20, 1960—PLANT VISITATION

1:30 p.m.

The Cincinnati Milling Machine Company, Cincinnati, Ohio. Busses leave Netherland-Hilton Hotel entrance at 1:30 p.m. A guided tour with emphasis on application of lubrication.

Thursday, April 21, 1960

8:30 a.m.—12:00 noon

A Lubrication Engineer Looks at Hydraulic Problems: Bruce Dunham, Technical Consultant, Sun Oil Co., Philadelphia, Pennsylvania

All phases of hydraulic fluid, performance and maintenance of hydraulic machinery will be discussed.

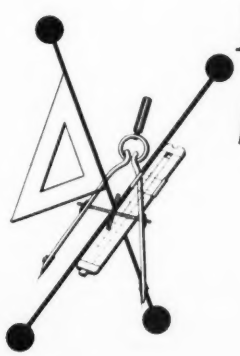
Plant Lubrication & Organizing a Plant Lubrication Program: Ken Smiley, Lubrication Engineer, E. I. duPont de Nemours & Co., Inc., Pennsgrove, New Jersey

Introduction, responsibilities, lubricating consultation, coding, trouble shooting, miscellaneous assignments, design collaboration, training programs, lubrication methods, cost reports, intangible savings, and estimated tangible savings will be covered in the final session of the course.

Question and Answer Panel: Moderator: Marco Petronio, Pitman-Dunn Lab., Frankford Arsenal, Philadelphia, Pennsylvania

Panel is made up of all course lecturers. Questions submitted on cards during the course will be answered at this time.

Students enrolled in the Education Course may attend any technical session on Thursday afternoon at no charge.



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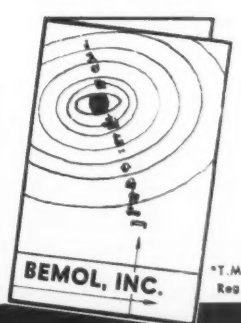

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Lubrication Abstracts

Edited by W. E. Campbell

Selected literature compiled by members of the Technical Committees and Industry Councils of the Society.

G. H. DeGroat, "200 Times the Punch Life with Metallized Moly," *American Machinist*, Dec. 30, 1957, 77.

Rear-axle housing flanges from ⅝ inch steel strip in blank, draw, pierce, cold-extrude, size, and trim progression gave poor punch life in sizing operation, because carbide punches broke, and chrome-plated punches were stripped under severe pressure. Sprayed 0.005 inch layer of Mo on punch was ground to 0.002 inch and punch life was extended from approx. 225 pieces to 50,000 pieces. (*Abstractor: N. C. Morrell.*)

"Mechanism of Copper Catalysis in Insulating Oil Oxidation" by C. N. Thompson (Shell Research Ltd.) J. Inst. Petroleum, v. 44, no. 417, 1958, pp. 295-309.

Tests show that copper acts as a homogeneous catalyst, whether it is present in metallic or soluble soap form. Therefore, the use of soluble copper to accelerate oil oxidation in certain test procedures is justified. The activity of the metal is not dependent on the corrosivity of the oil, but on its ability to maintain copper in solution rather than allow it to precipitate out. (*Abstracted by M. I. Smith*)

N. Zlatin (Metcut Research Assoc.), W. H. Friedlander (Curtis Wright Corp.), and C. F. Walton (Gray Iron Founders Society), "How to Machine Gray and Nodular Iron," *American Machinist*, v. 101, no. 10, 1957, 138-52.

This article is presented as a practical guide for machining cast iron. Grinding of cutting tools is considered from the standpoint of the type of machine, machine tool requirements, and power requirements. The machining properties of cast iron are discussed with regard to tool life, microstructure of cast iron, surface-finish requirements, factors which produce distortion, and the selection of fluids. General machining recommendations are presented in terms of tool materials, cutting fluid selection, power requirements, speed rate, type of tools for turning, milling, drilling, reaming, and tapping. Examples are given by which optimum cutting speed and feed rate may be determined to establish the most economical method of machining of cast iron. (*Abstractor: D. F. Miller.*)

A. V. Fraioli, "A Study of the Interactions of Polar Organic Molecules with Metal and Metal Oxide Surfaces," Dissertation, Lehigh University, 1956 (Available from University Microfilms, Ann Arbor, Michigan).

The relative lubricating efficiency of a variety of organic vapors is measured with a static friction apparatus operating on the inclined plane principle. Coefficient of friction is measured as a function of the equilibrium pressure of the adsorbed phase. Static friction is found to decrease to a minimum in the region of monolayer coverage. Correlation is found between the molar polarization of the bulk liquid of the adsorbed vapor and the lubricating efficiency. It is proposed that the forces of polarization are variables in the adhesion of physically-adsorbed films and thus involved in the mechanism of lubrication. This phase of the work is preceded by a study of the adsorption of organic vapors on metal and metal oxide surfaces. The adsorption measurements are taken for water, ethyl alcohol, butyl chloride, and nitropropane, adsorbed on reduced iron, oxidized iron, bulk iron oxide, and titanium oxide. (*Abstractor: Douglas Godfrey.*)

"A New Three-ball Tester for Roller Bearing Lubricant Greases," by G. Conti, La Rivista RIV (Italy), v 7, April 1958, pp 15-22 (in Italian) E.T.D. n 2621

The apparatus consists of a cup-shaped bearing race in which three large steel balls are rotated by a distance cage. The cage is belt driven at a speed of 300 to 600 rpm. A spring-loaded dynamometer indicates the cup's entrainment torgue about its vertical axis by the friction exercised by the balls. A dial indicator impinging on the cup measures the distortion in the thickness of grease film between the balls and the annular wall of the cup. At intervals during a five hour run, the torgue, film distortion, grease density and temperature are measured. These four sets of plotted data are compared with similar data on other greases whose quality and performance are known. From the comparison, the long term performance of the grease on test can be quickly appraised. (*Abstracted by E. H. Loeser*)

J. J. Durnan (Behr-Manning Co., Troy, N. Y.), "Why Abrasive Belts Need Grinding Fluid," *American Machinist*, v. 101, no. 10, 1957, 160-61.

Two types of grain wear are characteristic of abrasive belts; fracture, when

grains break, and attrition resulting from friction against the worked metal. Ideal cutting conditions exist when there is slight attrition, then fracture, slight attrition, etc. Wear is important in abrasive belts because the belt cannot be removed and resharpened. Grinding fluids are effective in improving surface finish, reducing belt loading, and lengthening belt life. Any fluid will be beneficial by providing a film between the belt and the work through which sharp grains penetrate. Suggested oils are those containing chemically active materials such as chlorine or sulfur. Mixtures of mineral and lard oil have advantages because of their low cost. The harder the metal, the higher the concentration of lard oil required. Emulsions have also been found suitable for use with water proof belts. When high surface finish is desired a heavy grease may be used. If heavy stock removal is required, light greases have been found to be suitable. Greases used should have a low melting point. (*Abstractor: D. F. Miller.*)

M. G. Hugel, "Lubrication Experiments Carried Out with Oil-Soluble Molybdenum Complexes," (In French), Rev. inst. franc. petrole et Ann. combustibles liquides, v. 10, 1955, 1280-83.

Graphite and molybdenum disulfide are effective solid lubricants in systems of rubbing metals. These substances may be precoated on surfaces or colloidal suspensions in a carrier can be used. A more convenient means of providing a solid lubricant is to use an oil-soluble compound which will decompose at the high temperatures generated on the surfaces during severe rubbing conditions to produce the solid.

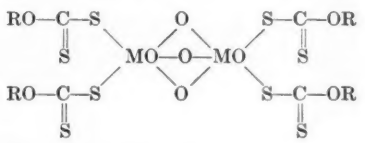
The following conditions must be fulfilled:

(1) the compound has to be soluble in mineral, vegetable, or synthetic oils,
(2) the solution must not deposit solids below 120°C,
(3) the additive must liberate a solid at excessive temperature and pressure conditions where ordinary oils are ineffective,
(4) the solid must be unctuous, which would stem from a laminar crystal structure.

Because of condition (4), the sulfides of molybdenum, tungsten, mercury, titanium, and tin are suitable.

Attention is focussed primarily on molybdenum compounds. First the thiomolybdates of nitrogen bases are tried. While their solubility in mineral oils is low, oxygenated lubricants such as the polyethylene glycols are suitable, and a brown sulfide of molybdenum is deposited from the blends on metal during rubbing.

Then the molybdenum xanthates [*Montequi, Am. espan. fis. quim.*, 28, 1930, 481 were studied. These have the formula



Derivatives in which R = hexyl, octyl, decyl, and dodecyl were prepared. Lengthening of the hydrocarbon chain increases solubility of the compound in mineral oil while lowering its decomposition temperature. For effective E.P. lubrication, substances must decompose rapidly at 180–200°C. The molybdenum alkyl xanthates derived from an alcohol below hexanol decompose >300°C. The deposit produced at the instant of decomposition is $MoOS_2$. While it adheres to iron, it will be worn through unless continually reformed by the doped lubricant.

Experiments with the Four-Ball E-P Tester show 2 per cent molybdenum decylxanthate in SAE 30 oil to be especially effective when load is increased continuously during a run (using the same specimens and lubricant charge), as contrasted to the usual test procedure which is a one minute run at constant load. Details are given in Tables 1 and 2. This experiment shows that a definite time interval is required to form the protective film, and that it is insufficient when load is applied all at once.

Pretreating the balls with an 8 per cent molybdenum xanthate blend at 300–320°C produces a precoated film which is effective; see Table 3 in which the entire load is applied at once.

Practically identical results are obtained with precoated specimens when a 2 per cent molybdenum decyl xanthate blend instead of the 4 per cent blend is used in the run.

Experiments are also made with balls pretreated with xanthates, and run subsequently in a 1 per cent blend in SAE 30 oil of a soluble molybdenum blue complex [Hugel, French Patent No. 661, 055]. Table 4 shows the molybdenum blue blend to be superior to the molybdenum decyl xanthate blend described above.

(*Summary of Foreign Paper, by M. Antler, Ethyl Corp., Detroit, Mich.*)

TABLE 1

Lubricant: 2% Molybdenum decyl xanthate (constant load)

Load (kg.)	70	120	130	140
Seizure delay (sec)	>60	>60	18.3	0.8

TABLE 2

Lubricant: 2% Molybdenum decyl xanthate (increasing load)

Load (kg.)	120	150	180	200	240	260	280	300	320	340	380
Seizure delay (sec)	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
Coefficient of friction	0.09	0.14	0.16	0.13	0.25	0.23	0.24	0.18	0.18	0.15	0.11
Scar diameter (mm.)											1.1

TABLE 3

Lubricant: 4% Molybdenum decyl xanthate (precoated balls; constant load)

LOAD (KG.)	SEIZURE DELAY (SECS.)	COEFFICIENT OF FRICTION			WEAR SCAR (MM.)
		BEFORE SEIZURE	MAXIMUM	AFTER SEIZURE	
220	55	0.12			0.68
250	43	0.11			0.75
280	26.5	0.12	0.14	0.09	0.88
310	13	0.11	0.18	0.08	1.15

TABLE 4

Lubricant: 1% Molybdenum blue (precoated balls; constant load)

LOAD (KG.)	SEIZURE DELAY (SECS.)	COEFFICIENT OF FRICTION			WEAR SCAR (MM.)
		BEFORE SEIZURE	MAXIMUM	AFTER SEIZURE	
280	60	0.14			
350	39	0.22	very weak	welding of balls at 57 sec.	0.82

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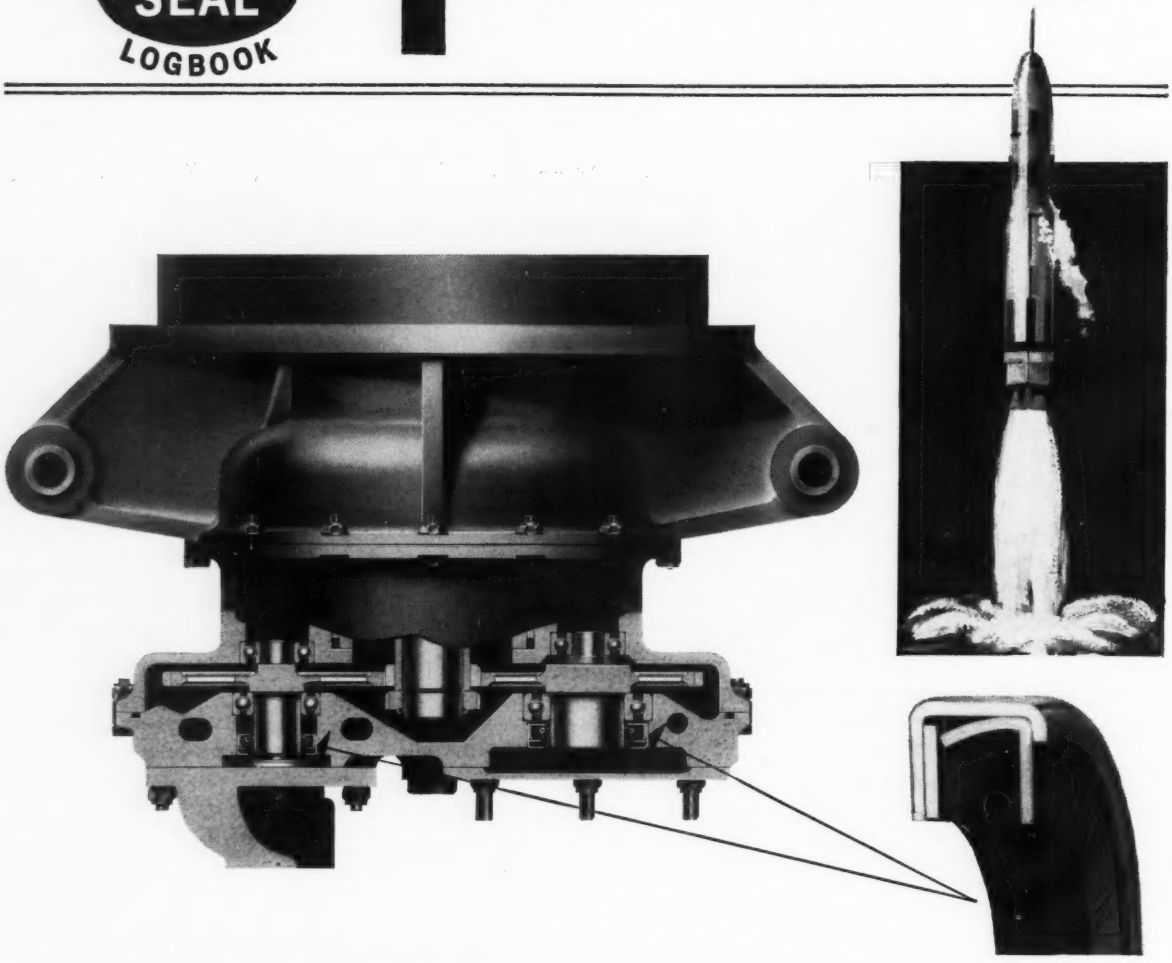

Aerojet-General solves sealing problem on shafts accelerating 0 to 3,800 rpm in 1 second

Zero to 3,800 rpm in 1 second, on 1" band 1½" shafts. Synthetic-base lubricant to retain. Magnesium housing. Operating temperatures —65° F to 300° F. Utmost dependability an absolute essential. These are typical of operating conditions in the turbopump gear boxes of the first and second stages of the Titan missile.

Aerojet-General and National Seal engineers answered the shaft sealing problem on the 3,800 rpm shafts by adapting a standard-design National Oil Seal. The seal's outer case is aluminum for light weight and to match closely the coefficient of expansion of the magnesium housing. The tensioning spring is stainless steel, unaffected by synthetic lubricants. The single-lip sealing member is a specially compounded Buna N synthetic rubber, specifically designed for use with the synthetic-base lubricant.

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Patent Abstracts

Compiled by Ann Burchick
Aluminum Co. of America

Synthetic Lubricating Composition, Patent 2,796,441 (J. K. Mertzweiller, assignor to Esso Research & Engineering Co.) A process for the preparation of formal lubricating compositions which comprises reacting (1) a crude alcohol mixture obtained by the reaction of a mixture of substantially C_{12} to C_{18} olefins with carbon monoxide and hydrogen, thereby obtaining a mixture of products which is then further hydrogenated to form said crude alcohol mixture, and (2) a formaldehyde donor selected from the group consisting of formaldehyde, paraformaldehyde, formalin and hexa-methylene-tetra-amine; at a temperature of about 150-300 F. in the presence of an acidic catalyst and stripping the mixture of products thus obtained to vapor temperatures equivalent to about 650 to 750 F.

Soluble Oil and Preparation, Patent 2,797,-197 (N. Thompson and W. K. Parcells, assignors to Sun Oil Co.) A soluble oil composition capable of forming stable oil-in-water emulsions which comprises: mineral lubricating oil; alkali metal petroleum mahogany sulfonates; material selected from the group consisting of the saponified, normally liquid product obtained by partial oxidation of petroleum foots oil and having saponification number in the approximate range from 60 to 100 mg. of KOH per gram and a mixture of said product in saponified form and alkali metal petroleum naphthenates; a coupling agent in minor proportion to stabilize said soluble oil; and a minor proportion of water to stabilize said soluble oil; said composition containing from 0.3 to 1.0 weight percent of organic SO_3 and having total carboxylate saponification number equivalent within the approximate range from 10 to 20 mg. of KOH per gram, at least 2 mg. of KOH per gram of which are provided by said product.

Preparation of Grease Thickeners from Oxo Reaction Products, Patent #2,801,977 (A. J. Morway, J. H. Bartlett and J. C. Munday, assignors to Esso Research & Engineering Co.) A process for the preparation of new and useful grease forming materials which comprises the steps of subjecting an olefin to the action of carbon monoxide and hydrogen in the presence of a carbonylation catalyst at pressures within the range of from 100 to 300 atmospheres and at temperatures within the range of from 200 to 400 F. to obtain a mixture of products, acidifying said mixture of products with an aqueous acidic material and heating to a temperature of about 80 F. to about 300 F. for from 10 minutes to about 20 hours, adding to the heated mixture of products an alkali in amounts sufficient to insure a mol ratio of alkali to said mixture of products of from about 1:10 to about 1:20 and maintaining the temperature at about 30 to about 200 F. for from about 1 to about 10 hours, raising the temperature to about 210 F. to about 350 F. and maintaining it within that range until the evolution of water has substantially ceased, again raising the temperature to about 390 F. to about 500 F. for from about 5 to about 10 hours, adding a metallic hydroxide to the heated mixture in amounts sufficient to insure a mol ratio of said hydroxide to said mixture of products of from about 1:1 to about 2:1, and raising the temperature to about 500 F. to about 650 F. for about ½ hour to about 5 hours to obtain the desired final product.

Emulsifiable Oil Composition, Patent #2,-802,786 (J. D. Oathout, assignor to Esso Research & Engineering Co.) An emulsifiable metal working oil composition comprising a major proportion of a lubricating oil and a minor proportion sufficient to render said oil emulsifiable, of a sulfonate-naphthenate material obtained by separating an organic layer from the extract formed in the extraction of mineral base lubricating oil of high naphthenic content with an aqueous solution of water-soluble sulfonate material selected from the group consisting of sodium xylene sulfonate, sodium toluene sulfonate and mixtures thereof, and sodium hydroxide.

Lubricants, Patent #2,804,430 (A. G. Rocchini, assignor to Gulf Research & Development Co.) A non-staining composition for the lubrication of aluminum, magnesium, and like metals during severe cold working consisting essentially of 2-½ to 40% sodium methyl siliconate, 2-½ to 30% of a mixture of a mineral oil having a SUS viscosity at 100 F. in the range of 50 to 300 and an emulsifier in minor amounts sufficient to form a stable dispersion of the mineral oil in water, and 50 to 95% water.

Lubricating Compositions, Patent 2,796,406 (L. E. Lorensen, assignor to Shell Development Co.) A mineral lubricating oil composition comprising a major amount of waxy mineral oil and a minor amount, sufficient to effectively decrease the pour point of said oil, of an oil-soluble linear polymer.

Rust Preventative Compositions of Matter, Patent 2,796,407 (E. K. Fields, assignor to Standard Oil Co.) A lubricating oil composition which essentially comprises a major amount of a mineral lubricating oil base and a minor amount of an N-alkyl-N', N'-di(carboxymethyl) urea containing from about 10 to about 40 carbon atoms in the alkyl group sufficient to provide protection against rusting.

Process for Preparing Mixed-Salt Grease Compositions, Patent #2,850,458 (A. Beerbower and H. E. Bloomsburg, assignors to Esso Research & Engineering Co.) A process for the manufacture of a lubricant comprising lubricating oil and about three to 50 weight per cent of a mixed-salt complex comprising alkaline earth metal salt of a C_1 to C_6 fatty acid and alkaline earth metal salt of a higher molecular weight fatty acid selected from the group consisting of intermediate and high molecular weight fatty acids and mixtures thereof, which comprises forming a slurry containing alkaline earth metal base and at least a portion of the lubricating oil, passing a stream of said slurry to a high intensity mixer, simultaneously passing to said mixer a second stream comprising said C_1 to C_6 fatty acid, one of said streams also containing said higher fatty acid, intensely mixing said streams in said mixer whereby said C_1 to C_6 fatty acid is dispersed in said slurry in the form of droplets of less than 0.05 mm. diameter, incorporating the remainder of said oil, heating to about 250 to 550F and cooling to form said lubricant.

Lubricating Grease Compositions Containing Soaps of Oxidized Petroleum Hydrocarbons, Patent #2,850,459 (L. A. Mikeska, A. J. Morway and C. A. Cohen, assignors to Esso Research & Engineering Co.) A lubricating grease composition comprising a major proportion of mineral base lubricating oil thickened to a grease consistency with a thickner consisting essentially of 5 per cent to 15 per cent by weight, based on the total composition, of an alkali metal soap of high molecular weight carboxylic acids derived from fatty materials, 5 per cent to 15 per cent by weight of an alkali metal soap of saponifiable materials produced by the oxidation of white oils which are highly refined petroleum oils of naphthenic nature, and 2 per cent to 6 per cent by weight of a salt of a carboxylic monobasic acid containing one to 5 carbon atoms per molecule and a metal selected from the group consisting af alkali metals and alkaline earth metals.

Modification of Oxidized Hydrocarbons and Products Therefrom, Patent #2,890,125 (F. E. Mange, assignor to Petrolite Corp.) The process which comprises reacting (A) an oxidized essentially non-benzenoid hydrocarbon obtained by the conventional oxidation of a non-benzenoid hydrocarbon mixture having a melting point in excess of 50 C so as to yield a product having an acid number greater than about ten and (B) an organic compound containing as the sole reacting groups a plurality of separate and distinct groups selected from the group consisting of isocyanate and thioisocyanate groups; the ratio of reactants being within the range of 92-98 per cent (A), and 8-2 per cent (B), conducted at temperatures within the range of the melting point of the oxidized hydrocarbon mixture to 150 C for at least about one hour.

Process for Removal of Metal Contaminants From High Boiling Oils by Use of Boron Compounds, Patent #2,891,004 (W. J. Mattox, assignor to Esso Research & Engineering Co.) An improved process for the removal of iron, nickel and vanadium contaminants from a hydrocarbon oil boiling above about 750 F which comprises contacting said oil with from about 0.5 to about 3 per cent by weight, based upon the oil, of a boron compound selected from the group consisting of boron oxide and boric acid at a temperature above about 250 F; separately recovering a boron complex and decontaminated oil; decomposing said boron complex with steam; and recovering at least a portion of said boron compound.

Titanium Coordination Compounds as Corrosion Inhibitors, Patent #2,891,910 (M. J. Furey, assignor to Esso Research & Engineering Co.) An oil composition comprising a major proportion of a mineral oil and a minor rust inhibiting proportion of a compound formed by the reaction of an alkyl titanate having the general formula $(RO)_4Ti$ wherein each R represents an alkyl radical containing between two to eight carbon atoms with an alkyl primary amine having between about 16 and 24 carbon atoms per molecule and wherein the mole ratio of said amine to said titanate is between one to one and two to one.

Floatation Type Rust Preventive, Patent #2,892,724 (R. A. Westlund, Jr. and H. W. Rudel, assignors to Esso Research & Engineering Co.) A floatation type of rust preventive having a flash point above 335 F, a pour point below 15 F, and a specific gravity below 22.5, consisting essentially of: 97.7 to 94.3 wt. per cent of a heavy petroleum distillate having a viscosity at 210 F in the range of 50 to 100 ssu, a viscosity index in the range of 20 to 100, a boiling point in the range of 350 F to 750 F at ten mm. mercury, and an API gravity in the range of 22.5 to 17.5; one to two weight per cent of a sulfonate selected from the group consisting of calcium and barium sulfonates having an average molecular weight in the range of 800 to 1000; 0.3 to 0.7 weight per cent of an unsaturated straight chain fatty acid having in the range of 16 through 20 carbon atoms per molecule; and one to three weight per cent of a substituted imidazoline.

Removal of Metal Contaminants from High Boiling Oils, Patent #2,891,005 (R. L. Heinrich, assignor, by mesne assignments, to Esso Research & Engineering Co.) A method for removing metallic contaminants from a residual asphaltic petroleum fraction the major portion of which boils above about 900 F containing metallic contaminants which comprises contacting said petroleum fraction at a temperature gradient in the range between 750 and 825 F with a sulfur-insensitive cobalt molybdate hydrogenation catalyst in the presence of hydrogen at a pressure in the range from 400 to 3000 pounds per square inch gauge and at a space velocity in the range between 0.25 and 5.0 v./v./hr to form microcoke particles separable from the contacted fraction and containing said contaminants, removing said contacted fraction from contact with said catalyst, separating said microcoke particles from said contacted fraction, and recovering said contacted fraction containing a substantially reduced amount of metallic contaminants.

Lubricating Grease Thickened with Ultramarine Blue, Patent #2,892,776 (J. F. Lyons and N. R. Odell, assignors to Texaco Inc.) A lubricating grease comprising a lubricating oil as the predominating constituent, and about five to 45 per cent by weight, based on the weight of the grease, of ultramarine blue in finely divided form, having a particle size from about 0.05 to about 3.0 microns in diameter.

Process for Preparing Improved Synthetic Ester Based Grease Compositions, Patent #2,892,777 (A. J. Morway, assignor to Esso Research & Engineering Co.) A process for the preparation of new and useful lubricating grease compositions having extreme pressure resisting properties and having utility over broad temperature ranges which comprise the steps of thickening a synthetic diester lubricating oil as the sole base oil with a complex salt-soap thickening agent, the mol ratio of said salt to said soap being within the range of from 1:1 to 10:1, allowing said lubricating grease to remain quiescent until it has attained its maximum degree of hardness, blending with said hardened grease a minor but diluting quantity of additional synthetic oil sufficient to result in a mixture containing from about five to 30 per cent by weight of said thickening agent and subjecting the diluted grease to the action of high rates of shear in the order of from about 250,000 to 750,000 reciprocal seconds under streamlined conditions at temperatures below about 200 F to obtain a finished grease composition.

Low Temperature Method for Preparing High Temperature Greases, Patent #2,892,778 (C. F. Carter and J. L. Dreher, assignors to California Research Corp.) A process of preparing a high melting point grease composition comprising forming a blend consisting essentially of a lubricating oil, a monoester of terephthalamic acid in an amount such that the soap thereof thickens said lubricating oil to the consistency of a grease, a basic substance selected from the group consisting of alkali metal and alkaline earth metal oxides and hydroxides, and a solvent for said basic substance, heating said blend to a maximum of 220 F temperature, subjecting said blend to a shearing force sufficient to form a soap of said monoester of terephthalamic acid and essentially simultaneously to stably disperse said soap of terephthalamic acid in said oil to thicken said oil to the consistency of a grease, said solvent being selected from the group consisting of alcohol and water, and wherein said basic substance is present in an amount sufficient to substantially neutralize said monoester of terephthalamic acid.

Soap-Thickened Grease Modified with Glycerine Ester of a Low Molecular Weight Carboxylic Acid, Patent #2,892,781 (H. G. Vesterdal, assignor to Esso Research & Engineering Co.) The method of preparing lubricating greases which comprises subjecting in a major proportion of a mineral lubricating oil a saponifiable material selected from the group consisting of fats and fatty oils of animal and vegetable origin to alkali fusion at a temperature of about 450 to 580 F in grease making proportions in the presence of about 0.1 to 2.0 weight per cent of a compound selected from the group consisting of di- and tri-esters of glycerine with low molecular weight aliphatic monocarboxylic acids having from about one to five carbon atoms per molecule, cooling and intimately mixing the product.

Lubricant Composition, Patent #2,892,783 (F. A. Stuart, W. T. Stewart, W. Lowe and F. W. Kavanagh, assignors to California Research Corp.) A lubricant composition comprising a major portion of an oil of lubricating viscosity and a minor portion sufficient to enhance the

detergent characteristics of the composition of an oil-soluble polyglycol substituted polymer of at least one monomer, said monomer containing a single polymerizable ethylenic bond and said polymer containing from about 40 to about 96 per cent by weight of hydrocarbon oil-solubilizing groups from said polymerized monomer and from about four to about sixty per cent by weight of polyglycol groups, said oil-solubilizing groups being selected from the class consisting of aliphatic and cycloaliphatic hydrocarbon groups of at least four carbon atoms each, said polyglyod groups being selected from the class consisting of polyalkylene glycols and monoalkyl ethers thereof having from two to seven carbon atoms in each alkylene group and a molecular weight between about 220 and 30,000, said polymer being substantially saturated and having a total molecular weight of at least about 50,000 and a solubility in oil of at least 0.5 per cent by weight, said polyglycols having at least 5 alkylene oxide units each and being attached by a single thermally stable organic linking group to said polymer.

Oxidation Resistant Lubricant Compositions, Patent #2,892,784 (O. L. Harle and J. R. Thomas, assignors to California Research Corp.) A lubricating oil composition having improved resistance against oxidation, said composition consisting essentially of a major proportion of a normally oxidizable oil of lubricating viscosity selected from the group consisting of mineral lubricating oil and hexa(2-ethylhexoxy) disiloxane, from about 0.1 to about five per cent by weight of a secondary diarylamine oxidation inhibitor selected from the group consisting of phenyl-2-naphthylamine and phenothiazine and from about 0.5 to about ten per cent by weight of a copolymer consisting essentially of dodecyl methacrylate and diethylaminoethyl methacrylate in a weight ratio of about 6.5:1.

Process for Preparing Lubricating Greases, Patent #2,888,402 (N. A. Nelson, assignor to Esso Research & Engineering Co.) A process for the preparation of lubricating crease compositions which consists of heating a mixture of a mineral oil and lithium hydroxide monohydrate with stirring to a temperature of about 220 F to liberate the water of hydration and dissolve the lithium hydroxide therein, adding to said heated mixture an amount of a fatty acid sufficient to result in a finished grease composition containing from about 2 per cent to about 30 per cent soap, continuing said heating and stirring until said metal hydroxide is completely saponified, adding a solution of a non-hydrated metal hydroxide selected from the group consisting of calcium hydroxide, magnesium hydroxide, zinc hydroxide and barium hydroxide in additional mineral oil in amount sufficient to completely saponify the fatty acid, heating said mixture with stirring to a temperature of about 250 F to dehydrate the mixture, and cooling the mixture to obtain a finished grease composition, and wherein is used about 0.5 to 3 parts by weight of said lithium hydroxide monohydrate per about 0.2 to 1.2 parts by weight of said non-hydrated metal hydroxide.

Perfluoroalkyl Phosphite and Phosphonate Lubricants and Lubricant Additives, Patent #2,888,481 (G. R. Wilson, assignor to Ford Motor Co.) A lubricant selected from the group consisting of fluorinated alkyl phosphites and fluorinated alkyl phosphonates.

Grinding Composition Vehicle, Patent #2,889,215 (E. W. Nelson, assignor to Continental Oil Co.) A non-emulsifiable abrasive composition vehicle comprising 93.3 to 65 weight per cent of a mineral oil having an ssu viscosity at 100 F of from 30 to 70, 5 to 25 weight per cent of a fatty oil selected from the group consisting of sperm oil, neatsfoot oil, and lard oil, 0.5 to 5 weight per cent of sodium dodecylbenzene sulfonate, and an amount of cup grease, containing from 10 to 30 weight per cent of an alkaline earth metal soap, characterized further in that said amount of cup grease will provide from 0.2 to 0.8 weight per cent of soap in said composition.

Gear Oil Compositions, Patent #2,830,952 (A. A. Manteuffel, E. W. Brennan and J. B. Stucker, assignors to The Pure Oil Co.) An extreme pressure lubricant consisting essentially of a major proportion of a mineral lubricating oil having incorporated therein sulfurized and phosphorized fatty oil in an amount sufficient to enhance the load-bearing capacity of said lubricant and an oiliness agent consisting of a C_1-C_5 alkyl ester of a C_{18} monohydroxy monobasic aliphatic acid in an amount sufficient to further increase, in synergistic cooperation with the sulfurized-phosphorized fatty oil, the load-bearing capacity of said lubricant.

Silicone Lubricating Oils, Patent #2,830,953 (E. D. Brown, Jr., assignor to General Electric Co.) A composition of matter capable of lubricating under heavy load at elevated temperatures consisting essentially of (1) a liquid polymeric organopolysiloxane containing an average of from about 1.98 to 2.25 organic groups per silicon atom and (2) from 0.01 to six per cent, by weight, based on the weight of (1) of a boron compound selected from the class consisting of the trimer of phenyl boron oxide, tris (cyclohexylcyclohexyl) borate, and tris-(diisobutyl carbinyl) borate and mixtures thereof.

Oxidation Resistant Lubricant Compositions, Patent #2,892,785 (O. L. Harle and J. R. Thomas, assignors to California Research Corp.) A lubricating oil composition having improved resistance against oxidation, said composition consisting essentially of a major proportion of a normally oxidizable oil of lubricating

(*Con't on page 128*)

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PATENT ABSTRACTS

(Con't. from page 127)

viscosity selected from the group consisting of mineral lubricating oil and hexa(2-ethylhexoxy) disiloxane, from about 0.1 to about five per cent by weight of an oxidation inhibitor selected from the group consisting of 2, 2-di(p-hydroxyphenyl) propane and t-butylcatechol and from about 0.5 to ten per cent by weight of a copolymer consisting essentially of dodecyl methacrylate and diethylaminoethyl methacrylate in a weight ratio of about 6.1:1.

Synthetic Lubricating Composition, Patent #2,889,281 (A. H. Matuszak and A. J. Morway, assignors to Esso Research & Engineering Co.) A fluid synthetic lubricating composition having improved extreme pressure resisting characteristics consisting essentially of (1) a major proportion of a lubricating oil base consisting of (a) 80 to 99 per cent by volume of a dialkyl ester of a dicarboxylic acid and (b) 1 to 20 per cent by volume of a complex ester; (2) about 0.25 to 2 per cent by weight, based on the lubricating oil base, of an antioxidant; (3) about 2 to 25 per cent by weight, based on the lubricating oil base of dimethyl silicone polymer having a viscosity at 25 C of about 3 to 20 centistokes; and (4) about 0.001 to 0.1 per cent by weight, based on the lubricating oil base, of a second dimethyl silicone polymer having a viscosity of 25 C of at least about 10,000 centistokes.

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CHARACTERISTICS OF LUBRICATING METHODS

(Con't. from page 104)

Lubricant leakage. . . . In many cases it is just as important to correctly handle the used lubricant as it is to apply it properly in the beginning. This is particularly true in operations where perishable products are handled such as in the food and textile industries and where contamination must be avoided. However, oil leakage in any machine is a detriment to safety and cleanliness. In most cases the leakage problem could have been avoided had more care been given to the problem when the installation was in the initial planning stage.

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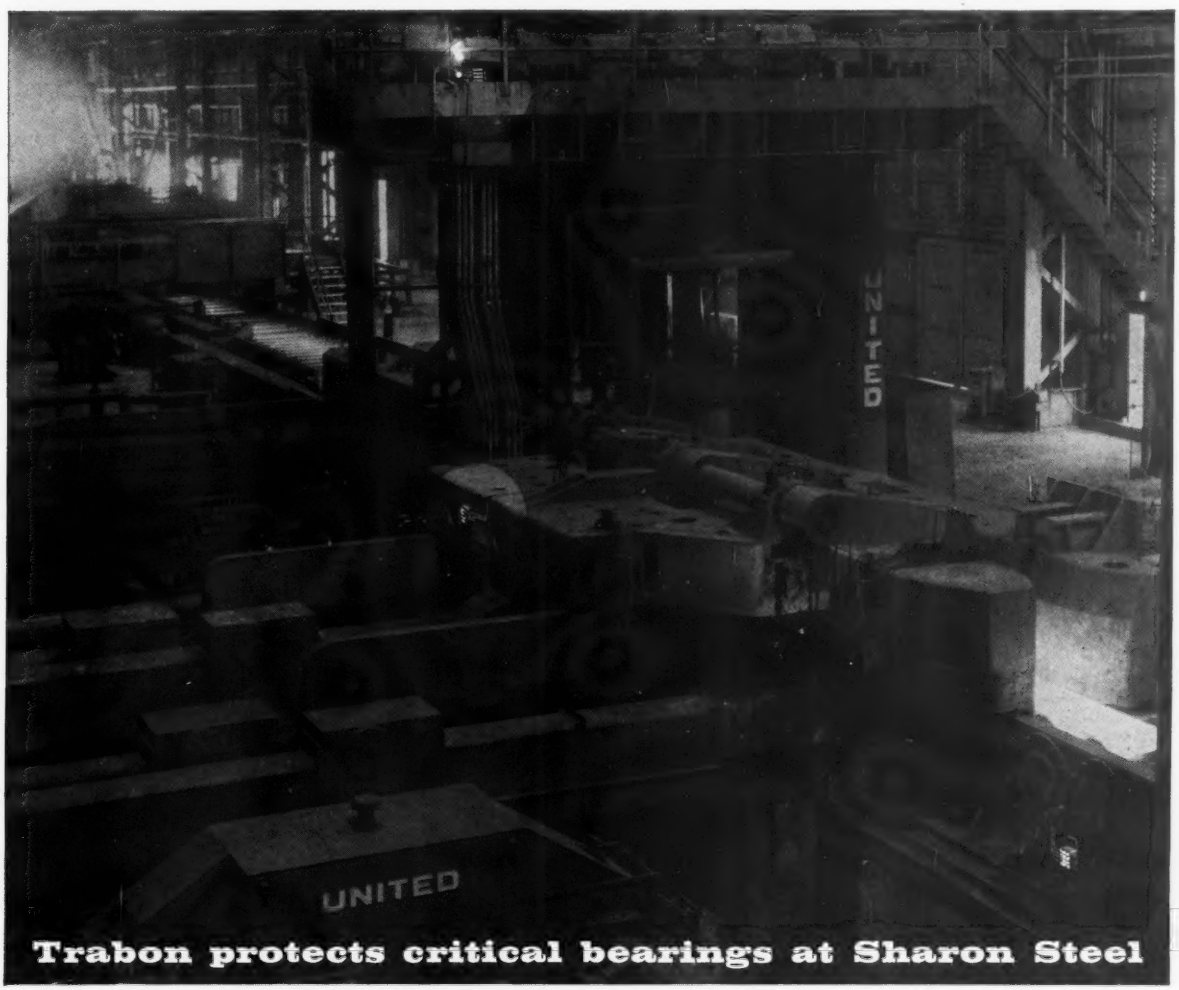

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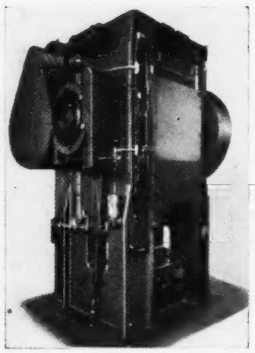

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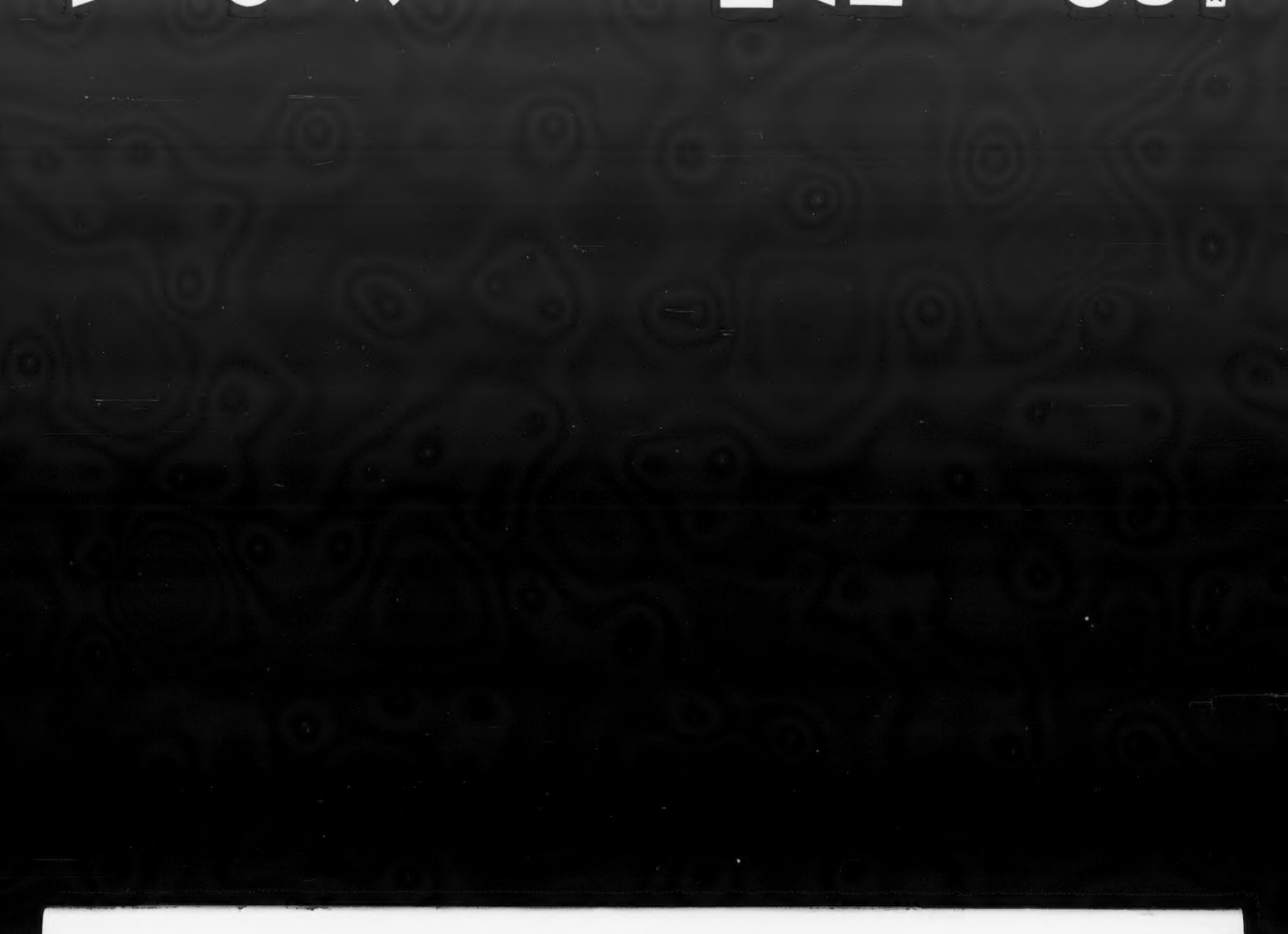
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